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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

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Forthcoming Events

APRIL 12

Institute of Metals (London Local Section):—Annual general meeting in the Rooms of the Society of Motor Manufacturers and Traders, Limited, 83, Pall Mall, London, at 7.30 p.m. Open discussion.

Institute of British Foundrymen

APRIL 4

London Branch:—Annual general meeting at Charing Cross Hotel, London, at 8 p.m. Short Paper competition.

APRIL 7

Lancashire Branch:—Annual general meeting at Engineers' Club, Manchester, at 4 p.m. "Production Costs and Selling Prices," Paper by A. Hodson.

APRIL 11

Lancashire Branch (Preston Section):—Annual general meeting at Technical College, Preston, at 7.30 p.m. "Moulding Machines and Fettling Plant," Paper by F. W. Neville.

APRIL 13

Middlesbrough Branch:—Annual general meeting at the Cleveland Scientific and Technical Institute, Middlesbrough, at 7.45 p.m. Further Report of Technical Section. Short Paper and general discussion.

APRIL 14

West Riding of Yorkshire Branch:—Meeting at the Technical College, Bradford, at 6.30 p.m. "Foundry Costs," Paper by F. Whitehouse.

APRIL 20

Sheffield and District Branch:—Annual general meeting at the Grand Hotel, Sheffield, at 7.45 p.m. "Alloys in the Ironfoundry," Paper by J. Roxburgh.
Birmingham, Coventry and West Midlands Branch:—Annual general meeting at the James Watt Memorial Institute, Birmingham, at 7.30 p.m. "The Mechanical Production of Cores," Paper by W. J. Molineux.

Standardisation of Castings

Because the British Standards Institution has, *force majeure*, had to attach to its Committees a number of men of undoubted scientific attainments, the average man in the street is inclined to regard standardisation as an academic question quite remote from practical politics. This is quite an erroneous impression, as it is only by standardisation that the cost of manufacture can be reduced. It is one of the most important commercial factors at the present time in British industry, though the B.S.I. has no direct interest in such matters. Take the question of rainwater goods, for instance. For a foundry to be in a position to supply any type demanded by the builders' merchants, it must carry several thousands of patterns. These are capable of being reduced very materially, and we ask ironfounders when they receive inquiries for non-standardised types—even though they possess the patterns—to ask their customers' permission to supply British standardised types. The limiting of types to reasonable dimensions makes employer co-operation so much easier.

Internationally, standardisation is of profound importance, and now that the Dominions are co-operating in a whole-hearted fashion, it will do much to facilitate inter-imperial trade. Generally speaking, there are two aspects of standards which require differentiation. One relates to the postulation of minimum acceptance tests, viewed from the physical and chemical aspects. The other type, merely catalogues standard sizes, and this is the more important one, as it reduces the cost of manufacture and storage, whilst the former institutes a control on properties.

It should be borne in mind that the British Standards Institute originate nothing. They act on the expressed wishes of industry, preferably put forward by an employer's federation or a scientific association, but if an obvious case is presented by an individual firm it will receive proper consideration and action.

Years ago we suggested to Mr. Cooper the preparation of a Paper on the standardisation of simple foundry tools, and we now further suggest that the time is ripe for action to be taken in this direction, as its creation would help at reducing just a few more variables in foundry practice.

Malleable Specifications—I.

The care which must be exercised in the preparation of printed reports has been recently illustrated by an article in an engineering journal, which gives a review, for the benefit of engineers, on malleable cast iron as an engineering material. Among other things, the article quotes the conclusions of the Malleable Iron Sub-Committee of the Institute of British Foundrymen to the effect that the standard set by malleable specifications is low, easily attained and often exceeded, coupled with the suggestion that it should be raised.

The author quotes his experience with a considerable number of test-pieces, particularly of white-heart, which do not greatly exceed the required minimum values, particularly in the matter of elongation. He quotes figures from eighty tests obtained from bars supplied by eight foundries. The average elongation was 5.5 per cent., varying between 2 per cent. and 8 per cent., but with such figures nobody can deny that 5 per cent. elongation (as given by present British Standards Specifications) is a reasonable one for white-heart malleable in current commercial practice. We believe that the same point was made in the discussion on the above Paper, and was shown by the results quoted in the Paper itself.

Perhaps the suggestion of raising the figures arises from some confusion of thought as to the policy governing standard specifications. It can be regarded as a fixed principle with the British Standards Institution, as it is with specifying bodies, such as the Admiralty, that general specifications shall be of such a character as can be fairly met by the majority of firms in a given industry. We say general specifications advisedly, and the two malleable iron B.S.I. specifications fall into this category. They can be applied to any type or size of malleable cast iron other than those for which hydraulic or other pressure tests need to be specified. Any user can call for them. There is, of course, no reason whatever why new specifications embodying higher figures should not be introduced by mutual agreement between makers and users, but it is doubtful whether these will be general specifications. They are more likely to be specifications for high-grade material for special products or particular classes of service.

C

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Squatting of Oil-Sand Cores

To the Editor of The Foundry Trade Journal.

Sir,—I should be pleased if you could grant the writer of this letter a little of your correspondence-column space to ask a simple question. My question is: What is an oil-sand core? I suggest that at present every separate foundry executive, using core binders or even linseed oil by itself, with various types of sea, river-bed, washed or quarried sands, will have his own particular definition.

Reverting to the various remarks reported in your Journal, page 163, of March 8, 1934, centre column; are we to understand that a true oil-sand core (*i.e.*, a mixture of *sea sand* and linseed oil only?) can be made into a core, even 1 ft. tall, without the use of internal or external supports, and the addition of other sand, and still remain perfectly true in all dimensions during and after baking.

The writer's experience so far disproves this assumption, and *if* anyone can do as he seems to suggest, without lessening in any degree the chief advantages proved, for the using of oiled sea-sand cores he is, indeed, a master.

It is admitted that by suitable admixtures of red, sea, river and quarried sands, using dextrine, core gum, starch, flour and numerous other cereal bases; together with molasses, sugar, resin and similar types of bonding agents, certain results can be obtained which are fairly satisfactory, but which I contend nullify to a considerable degree the great advantages that the whole principle of the use of oil sea-sand cores confers on the harassed foundry owner and management.

What happens to such ameliorating factors as free venting, permeability, ease of manipulation, ease of fettling, cleanness of skin finish, no blowing, shrinkage of core on metal contraction and the many other inherent advantages of sea-sand-oil practice when resource must be made to the various other linseed-oil additions. They defeat its chief object; therefore, I am again forced to ask for a complete definition of the question: What is an oil-sand core?—Yours, etc.,

For A.E.B. Products, Limited,
Alfred E. Burton,
Managing Director.

Willenhall,
Staffs.
March 22, 1934.

Synthetic Sands

To the Editor of The Foundry Trade Journal.

Sir,—I have read with interest the report of Mr. R. C. H. Weeks' Paper on "Modern Iron Foundry Practice." In the opening paragraph he states that discussion is often the most valuable portion arising out of the presentation of a Paper, and leads to an exchange of ideas and experiences. I take this opportunity of criticising certain statements.

Under the paragraph of "Synthetic Sands," Mr. Weeks mentions that one or two foundries in the U.S.A. use it. He might be interested to know that during the year 1929, 30,000 tons of colloidal clay were used in American foundries. I should imagine that more than one or two foundries were responsible for this quantity.

He also mentions that a variety of tests have to be taken when using synthetic sand in the foundry and laboratory. The variety are:—

1. Bond strength.
2. Permeability.
3. Moisture.

As Mr. Hudson has proved conclusively, these tests should be routine operations in any sand system, whether synthetic or otherwise.

Further mention of synthetic sands are made in the Paper under Ford's Works. The author states "that use of synthetic sands throughout was interesting, but one wonders at the necessity for this, with good quality Erith sand about a mile away." The necessity of using synthetic sand should be obvious for the follow reasons:—

1. Synthetic sand is cheaper than natural bonded sand.
2. Gives more accurate control.
3. Gives a finish which as Mr. Weeks himself states is eminently satisfactory.

Again, to quote Mr. Weeks, the percentage of wasters on block castings was 5 per cent.

As I have no doubt Mr. Weeks will agree, the casting of small cylinder block castings is a difficult foundry proposition.

He remarks that dried cores were not blacked but coated with liquid flour, which was claimed to be much superior. From his Paper it could be assumed that the liquid flour could be made with cereal flour; this is not quite correct, as the material in use at Ford's Works is a prepared compound containing no cereal flour. This compound has been proved definitely superior and cheaper than blacking.—Yours, etc.,

W. Tait.

24, Martin Lane, Cannon Street,
London, E.C.4.

Sulphur Content of Cast Iron

It is generally assumed that the first iron tapped from the cupola is richer in sulphur than the subsequent heats. Many facts tell in favour of this view, among other things the occurrence of inverse chill in castings during the first heats. According to Bardenheuer, inverse chill is due to a high sulphur content and a low casting temperature, both exerting a strong supercooling effect upon the iron which, therefore, solidifies white, the outer layers becoming grey by the subsequent formation of temper-carbon-like graphite. In fact, the addition of pig-irons rich in manganese which renders the sulphur innocuous by the formation of manganese sulphide, make the inverse chill disappear.

The fact that inverse chill was also found in the later stages of the run induced Dr. A. Nehmitz* to investigate whether or not a relationship exists between the sulphur content of the iron and the melting time. On seventeen consecutive days samples for the sulphur determination were drawn from a cupola every fifteen minutes. The average values of the seventeen determinations of each series expressed in percentages of the sulphur content of the first sample, were as follow:—100, 93.8, 96.3, 100, 103.8, 107.3, 107, 110. It is to be seen that the sulphur content at first drops by about 5 per cent., reaches the initial value after 45 min., and then slowly approaches to a maximum value. Towards the end of the run another slight drop seems to take place, as some further tests showed. Since the output of the furnace in question was only tons, no definite conclusions can be drawn from the above data with respect to the variation of the sulphur content in longer melting periods. It is also possible that the operation of the cupola plays a part. To some degree, the results of the present investigation were confirmed by another foundry with a daily output of 60 tons in which two sulphur determinations were made, the first in the beginning of the run, the second at a later time chosen at will. The second sample showed sometimes a higher, sometimes a lower sulphur content than the first sample.

Messrs. A. Hall & Company, Limited, Footdee, Aberdeen, have received an order for another tugboat for the Union Cold Storage Company, Limited, London. Although the tug is of a small type, the order is an important one.

* "Die Giesserei" 1934, Nos. 3-4.

Random Shots

Appreciation is always pleasant and "Marksman" is glad to be able to put into print the following letter received from foreign parts:—

"Honoured Sir and Staff,

"I am reading with joy your once-a-week vivacious publishing, and felicit yourselves and other honourable sirs and staff members with pointed approval. The writings make pleasantness to me and others of my kidney, and we are sagely instruct by so clever penmanships. The market narrations showing of iron and steel, with also story about copper and her allies, are rushing into my brain and the remarkable force of this entry gives much nourishment for amiable thinking. Oh, sir, please put to your so facile Editor that I am respect to him, and of great obligations for his penning of smart precede articles on entering page. This work is of great bigness.

* * *

"I have remit annual price to ownerships of your publishing to facilitate weekly receipt to me in my own place, and am awaiting with fretfulness his coming every seven days. On the postman's entry I am red with satisfaction and clout him on the back as indication of inward joyous uprisings. This is a red day in my almanack and I am enjoyed with continuous bubblings of the spirit in destroying the postal wrappings of the edition. This is a sublime moment of foreboding and my pulsations are speeding rapidly in consequent ratio to blows of the heart. For such excellent moments of life I am owing your respectable Editor and manly helpmates many debts of thankfulness. Be so kind to adorn honourable occupier of editorial pew with congratulatory wreaths of praise-making. This preoccupied gent has certainly good wad of brains in noddle and comes out of scholastic stable.

* * *

"May I make pleasing sayings about staring print of 'Foundry Magazine'? Each word is grand and strikes the eyeball with sharp reverberation like impacting projectile. The gaps between prints are of a reasonable narrowness and the page boundaries compose themselves as beautiful counterfoils to presentation of reads. What shall I describe to the throng of adverts on first and rear pages of Foundry periodical? They are straightforward to make universal sex-appeal to all feminines as well as masculine genders and their wordings are to be clearly withstood. Kindly forgive Sir Marksman I am in some jeopardy to make not proper understandings, but you make concessions to foreign person and say inwardly, 'This bloke has lungs in right place.'

* * *

"I hopefully trust you peruse so far my indite of English words to make praises of honourable gents at Wellington Road. You are realising perhaps that I am grasping English vocab. at young age and am making much speech in British lingo with voyaging arrivals in this country. With sufficient money I am jaunting to English shores when time is seasoned and shall stand expectantly on Honourable Editor's door mat to remove travel marks of foggy English airs and variable muds. Pardon me I rap soundly on panels and await entry to den of great penman, who I am trustworthy will grasp me fistwise with excitable pants of greeting for product of foreign land.

* * *

"I am making great imaginings of this forthcoming incident, and perhaps with natural British fellowship you conduct me to pubs and other magnificents of metropolis. With similar indulgements our times together shall flee in great speedings until with many heartgriefs I must drop tearful leavetakings and pass from your anguished sights."

How's that for praise? Marksman.

The Potentialities of Cast Iron*

By A. B. Everest, Ph.D.

Introduction

Remarkable progress has been made in the metallurgy of cast iron during the past 10 years. During this time there has been a wide adoption of the alloy cast irons, including not only those with a small proportion of alloys, used to give improved properties in general engineering castings, but also the highly-alloyed heat- and corrosion-resisting austenitic cast irons. At the same time heat-treatment has become a commercial process as applied to iron castings, and other special methods of treatment, such as nitriding, have proved their worth. In many cases there is nothing novel in these processes from the metallurgical point of view, many of them having been developed for the treatment of steel and even of non-ferrous alloys. Where there is real advance, however, is in convincing the metallurgist and engineer that valuable results can be obtained by applying these refined processes to cast iron, the one-time "Cinderella" of the industrial metals.

This change of attitude is due largely to the better understanding of cast iron, which has resulted from recent research, and it is hoped in this Paper to show how the latest results of research are helping still further to raise engineering opinion of cast iron; to show how, in more respects than was ever imagined, it is superior to steels and other alloys, and generally to help one to realise the great potentialities of the alloy with which foundrymen are all so familiar.

In speaking of the potentialities of cast iron there is a danger of criticism by foundrymen who will be only too ready to complain that the use of alloy additions, of heat and other forms of treatment, are all too expensive luxuries for the average iron foundry. It is therefore of interest to remember that, when alloy cast irons were first introduced, there was a general feeling that cast iron was not worth the added expense and attention involved, yet to-day a number of foundries are making the manufacture and treatment of special cast irons a substantial part of their business; some of them even devoting themselves exclusively to the handling of these newer metals, thus proving up to the hilt that these developments have real commercial possibilities, and that the research results of one year become the industrial standards of the next, and cannot therefore be ignored by the practical foundryman.

It is, of course, impossible to say very much concerning the future developments of cast iron, since the possibilities which are already envisaged and which prove worth while rapidly become matters of accomplished fact. In dealing with the subject of the potentialities of cast iron it is therefore proposed to refer principally to recent developments both in practice and in research which will serve to suggest the possible trend of future progress.

Tensile Strength

Rightly or wrongly, in considering the properties of cast iron, tensile strength generally receives first attention. It is frequently questioned whether the tensile-strength figure for any particular cast iron is of any great value, but, nevertheless, extended experience shows that, not only are castings bought to a strength specification whilst machine design is based on empirical-strength figures, but also tensile strength is generally a good criterion of the quality of the metal, it being more or less closely related to many of the other properties of more direct interest to the engineer.

It is, therefore, of interest to realise the progress which has been made in the last few years in improving the strength of iron castings. Referring to his own experiences, the author recollects that, as recently as 8 or 10 years ago when he was conducting his own researches, it was a matter for special celebration when a test-bar, made even under the most careful laboratory conditions, broke with a strength of over 20 tons per sq. in., and strengths of this order were little known in commercial practice. Shortly after this popular ideas in connection with the strength of cast iron were rudely shaken by Piwowarsky's Paper[1] given in 1927, where strengths up to 47 tons per sq. in. were obtained in iron castings after a simple heat-treatment. This work was, however, of rather a specialised nature, and the results are even now not readily reproducible commercially. In the discussion of Coyle's Paper[2] given before the Cardiff Conference last year Smalley went even further and stated that cast iron has a potential strength of 60 tons per sq. in.

The degree of strength which can be attained in iron castings in practice, however, is generally a function of the form and quantity of the graphite flakes. Progress in making high-strength castings has therefore tended in the direction, firstly, of obtaining low total carbon (generally by control of the melting methods employed), and, secondly, by special metallurgical processes whose aim is to control the form of the excess carbon which separates as graphite in the metal.

Leaving aside the question of malleable cast iron for a moment, the degree to which the cast-iron industry has progressed in the past few years may be realised by the fact that castings of all sizes may now quite readily be supplied to a strength specification of 25 tons per sq. in., whilst still under commercial conditions, strengths as high as 32 tons per sq. in. in the "as-cast" condition have been achieved.

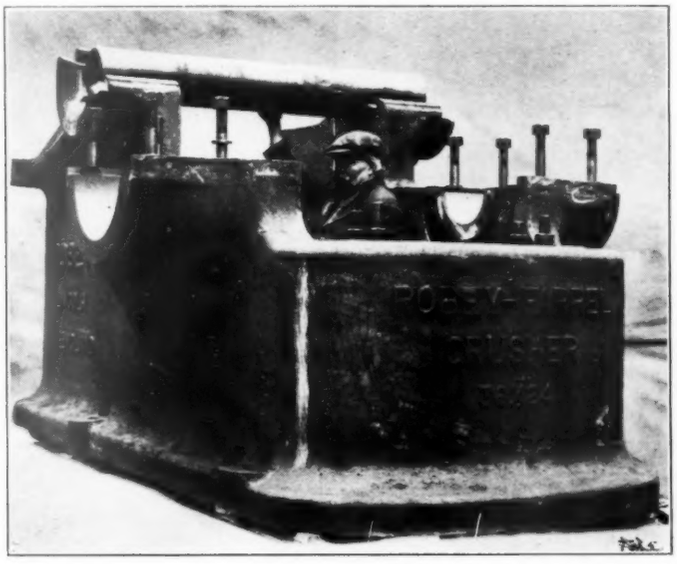


Fig. 1.—Large Crusher Frame Casting in 25-ton Tensile Iron.

Fig. 1 is of special interest in this connection, as it represents a casting whose finished weight was 17 tons, whilst the metal used was cupola-melted and treated by one of the modern inoculation processes involving the use of nickel. The casting was perfect and the test-bars cast with it broke at a strength of 25 tons per sq. in., whilst other tests taken from the risers gave figures which showed conclusively that, even in the middle of 9-in. sections, the metal had a strength appreciably over 20 tons per sq. in. It is of interest to mention that this type of iron is applicable not only to heavy castings, but is also widely adopted for quite small parts, including castings of only a few ounces weight.

Although such high-strength iron castings cannot compete with cast steel where toughness and ductility are concerned, nevertheless on strength alone these iron castings are approaching the figures frequently allowed for steel, and, with further development in this field, there is no doubt that, on strength considerations alone, iron castings will be able to compete with cast-steel, offering, at the same time, greater reliability and even superiority in some of its other mechanical properties, as will be enumerated below.

Two examples in which the modern high-strength cast irons have proved successful substitutes for cast steel are, firstly, in mine winding-drums, where, of course, reduction in scantlings and saving in weight are of vital importance from the point of view of power economy, and, secondly, in connection with engine flywheels. In applications of this type there is, of course, a limit beyond which cast iron would not be considered safe and cast steel would become necessary, but the present boundary between cast iron and steel is fixed arbitrarily in accordance with the old-fashioned ideas of engineers concerning cast iron. The introduction of the newer high-strength materials undoubtedly fully justifies the raising of this boundary and the restoration to the iron foundry of some of the work which has been lost to it by the increased demands for power and efficiency met on all sides in modern engineering practice.

Other methods of increasing the tensile strength of iron will be dealt with below in connection with heat-treatment, but, for the moment, what has been said above is sufficient to indicate clearly that, in their fight for existence, the foundries have already available materials of a strength some 25 or 30 per cent. greater than that previously known, whilst it is expected that the future will find a still further advance towards Mr. Smalley's ideal of 60 tons per sq. in.

* Paper read before the London Branch of the Institute of British Foundrymen, Mr. C. H. Kain presiding.

1 E. Piwowarsky, "On the Effect of Nickel and Chromium on the Strength Properties of Cast Iron," Foundry Trade Journal, 1927, Vol. 36, July 7, pp. 4-6.

2 F. B. Coyle, "American Progress in the Use of Alloys in Cast Iron," Inst. of Brit. Foundrymen, Foundry Trade Journal, July, 1933, Vol. 49, pp. 7-11.

Wearing Quality

It is difficult to discuss strength in iron castings whilst dissociating it from all the other physical properties. In many cases strength in a casting is demanded in combination with other features as, for example, wearing quality. In connection with resistance to wear, engineers are again realising that, after all, cast iron has much to recommend it, since it has proved in practice one of the best wear-resistant materials available. Tests carried out up to the present show clearly that, from the wear-resistant point of view, the modern high-strength irons are exceptionally good, and the combination of properties which they possess assures for them an ever-increasing application.

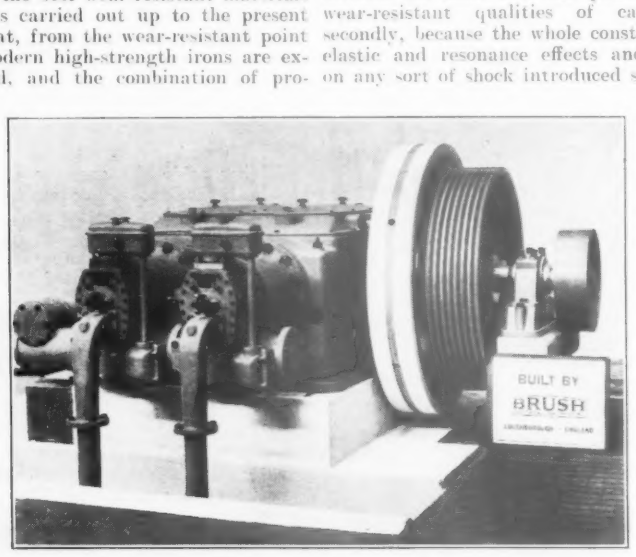


Fig. 2.—Modern Diesel Engine. In Engines of this Type High-Strength Iron finds Extensive Application for Flywheels, Pulleys and Cylinders and Heads.

An interesting example in which the use of a modern semi-steel iron alloyed with nickel and chromium has given a combination of strength and wearing quality is in connection with large press-dies, as used, for example, in pressing motor-car body sheets. It has in the past been the practice to make such dies in a common iron, using heavy sections and inserting hardened-steel pieces to take the load where exceptionally heavy wear is anticipated. With modern cast iron, however, this composite type of construction is no longer necessary, and the alloy irons, as already mentioned, will provide the engineer with all that he can desire from the point of view of strength and wear-resistance, even under the most severe conditions.

The quality of the modern alloy irons fits them, not only for the large press-dies, as mentioned for sheet-steel work, but also for smaller dies, as, for example, for drop stamping and hot pressing, the dies in these cases being frequently of an alloy composition and subsequently toughened still further by heat-treatment.

Further reference will be made below to the question of improved wear by control of the microstructure through heat-treatment and by modifications of composition.

Damping Out Vibration

On account of its good-wearing quality and its general rigidity, cast iron has for a long time past been used in many heavy structures as, for example, in building up machine tools. There is, however, another important and hitherto unsuspected property of cast iron, to which its success in this type of application is partly due, this property may be referred to as its power to damp-out vibration.

Recent work carried out on special apparatus to determine the vibration characteristics of various metals has revealed the rather surprising fact that cast iron possesses something like 20 times the vibration-damping power of carbon steel. This means to say that, in such applications as machine-tool frames, cast iron offers a greater rigidity and resistance to effects such as "whipping" than does steel. Since vibration and its effects are liable to be met in many engineering structures, this is an argument strongly in favour of the cast material, in meeting the competition of welded steel.

In a recent test, a lathe-bed was made up from steel, using welding as a method of construction. The steel bed was not a success, however, firstly, because the steel does not possess the inherent wear-resistant qualities of cast iron, but, secondly, because the whole construction was too elastic and resonance effects and "whipping" on any sort of shock introduced serious errors.

Fatigue Resistance

This power of cast iron to damp-out vibration, which presents a novel idea to the engineer, has been succeeded by another discovery which is, perhaps, even more remarkable. This concerns the fatigue resistance of cast iron. It is well known that, with the repeated reversal of stress, as, for example, in an axle, the constant reversal of stress may ultimately lead to failure of the part due to fatigue, although the loading may be appreciably below the ultimate strength figure for the material used. In the case of the steels, the limits to which the material may be stressed repeatedly are clearly all below the elastic limit of the metal and, in some cases, the safe range of loading (or fatigue range) may only be a relatively small proportion of the ultimate strength. In the case of cast iron, however, work which has been carried out by Kommers[3] shows that the endurance limit of cast iron can be as much as 80 per cent. of the breaking load and, at this figure, represents a relatively high proportion of the ultimate strength. Another point, however, which is of even greater interest, is that further researches[4] have shown that, in cast irons, the effects of grooves and notches in the specimen are very much less than is expected in most other materials. A specimen of cast iron, for example, with a radial hole which should have reduced the endurance limit 67 per cent., actually made a reduction of only 13 per cent. Two other specimens tested with filleted grooves, which were expected to reduce the endurance limit 74 per cent., actually showed 0 and 8 per cent. reduction respectively.

When, some 18 months ago, news first reached us that, in the United States, experiments were being made with cast iron for automobile crankshafts, engineers were inclined to regard the development with a great deal of suspicion, and never before had there been any suggestion that such a material as cast iron should be employed for so vital a part of an engine. Nevertheless reports of the successful application of cast iron in this case were actually confirmed and certain car manufacturers in the States adopted cast iron for their routine production.

Unquestionably the two properties discussed above, namely, the high endurance limits of cast-iron parts containing notches and grooves, and the power of iron to damp-out vibration, give an explanation of its success in this case, since the weakness of a crankshaft is generally due primarily to the bad effect of corners and angles in reducing the endurance limits of the shaft, this effect being greater in steel than in cast iron. Further, vibration effects at critical speeds are also liable to lead to premature breakdown, since it has been established that resonant vibration in a part sets up stress concentration of such an order that the additional stress required to cause rupture may be only relatively small. Surprising though it may seem, therefore, there appears to be very sound technical arguments in favour of cast iron for crankshafts and similar applications, and this development may have far-reaching effects on materials adopted in the construction of engines as for automobiles. Already a move towards the adoption of cast iron for crankshafts running under less severe conditions as, for example, in reciprocating pumps, has been made.

The effects of heat-treatment on cast iron have been dealt with adequately elsewhere.[5] Experience has shown that, by a simple treatment consisting of a quench in oil followed by tempering, strength improvements as high as 25 per cent. can quite readily be obtained with a wide control over hardness. Such improvements in strength may be realised not only in ordinary or low alloy cast irons but also in the new high-strength materials, so that ultimately figures as high as 40 tons per sq. in. may be attained. Although heat-treatment cannot generally be applied to any of the larger castings, nevertheless it is felt

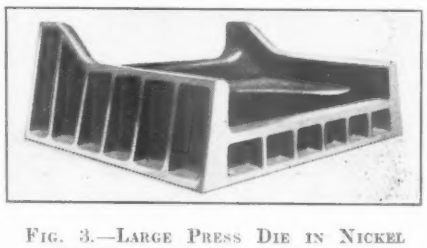


Fig. 3.—Large Press Die in Nickel High-Strength Cast Iron. Dies of this Type are used for Shaping Parts of Locomotive Boilers, and are, of course, not Dissimilar to those used in Pressing Automobile Bodies.

that there is a real possibility of developing further the strengthening and toughening of smaller castings by this process. In this case it has, of course, been found that the effect of alloy additions is of paramount importance and, in fact, except in the smallest sections, it can justly be said that the use of such additions has made heat-treatment possible, nickel being especially effective in slowing up the critical rate of cooling so that a milder treatment will produce the desired results.

Such heat-treatment, however, opens up very wide possibilities for getting a desired combination of strength, hardness and wearing quality in castings of all types, a special example of this being the localised hardening of parts such as gears, where the teeth may be given a high surface hardness by local treatment.

(To be concluded.)

[3] J. B. Kommers, "The Fatigue Properties of Cast Iron," Proceedings of the American Society for Testing Materials, Vol. 29, Part II, pp. 103-107 (1929).

[4] H. F. Moore and S. W. Lyon, "Fatigue Tests of Cast Iron," Transactions American Foundryman's Association, Vol. 35, p. 423 (1927).

[5] J. E. Hurst, "Oil-Hardening and Air-Hardening Cast Iron," Foundry Trade Journal, 1930, Vol. 43, December 4, pp. 385-386 and 395. Also J. E. Hurst, "Further Experiments on Oil-Hardening and Air-Hardening Cast Irons," Foundry Trade Journal, 1931, Vol. 45, December 31, pp. 405-408. A. B. Everest, "Cast Iron with Higher Nickel Additions," Foundry Trade Journal, 1932, Vol. 46, March 24, pp. 193-4 and 196.

Some Aspects of Non-Ferrous Founding

By Arthur Logan

(*Concluded from page* 195)

Foundry Faults

One of the greatest difficulties the foundryman encounters is that of bad design. Almost everyone who presents a Paper on foundry work mentions this point, yet the position seems to get no better—rather the reverse, for modern conditions, with the demand for weight reduction, seems to aggravate matters. It is common practice now to have branch or "T" pieces with a flange of 1 in. thick attached to bodies with sections only $\frac{7}{16}$ in. to $\frac{1}{4}$ in. Solid bosses of 2 in. dia. on sections $\frac{3}{8}$ in. thick are also frequently encountered. Such an example is shown in Fig. 9. This illustrates the tear which occurs if the heavy boss is not efficiently chilled. Usually, on investigation, it will be found that such a boss requires to be bored out for some fitting. The obvious thing, of course, is to have it cored out, but where this is definitely ruled out, then the only practical remedy is to use a fairly heavy internal chill. Fig. 10 illustrates a casting forming a half wormwheel, where there are two heavy-section rims connected by a light section. The heavy sections are 3 in. thick and are connected by a section $\frac{3}{4}$ in. thick. It is easy to see that trouble can be anticipated with such a casting. Fig. 11 shows how the connecting rib between the two heavy sections has torn. Correct casting temperature can do much to minimise difficulties of this kind.

Fig. 9.—Showing Tear between Sections.

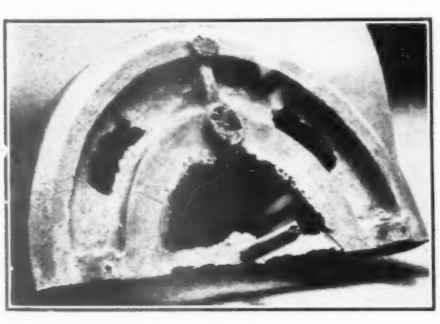


Fig. 10.—Half Worm-Wheel Casting.

The valve lid shown in Fig. 12 is a common type of casting, yet it presents difficulties—especially if, as is usually the case, the flange is thickened up out of proportion to the remainder of the casting. Fig. 13 shows where trouble is experienced. Another type of defect which is due to the mould is shown in Fig. 14. This occurs with green-sand work, and takes the form of small holes which look almost exactly like the wormholes one finds in old wood. These usually extend, as shown in Fig. 15, parallel to the body, and run through the fillet into the flange. They are usually found on the underside of the casting—the bottom half of the mould—but very occasionally they may occur in the top half. It will be noticed from Fig. 15 that the normal skin of the casting is disturbed at this point, and shows bright metal with a sort of flow-line effect. This gives the clue to the trouble, for the cause is excessive dampness of the sand at his point, either through using a low-permeability sand or a sand too wet; or, again, it may be due to the excessive use of the swab. Whatever the cause, the result is an intense evolution of gas over this small area, and as the evolution is greater than the permeability of the sand can cope with, a gas pressure is built up which takes the line of least resistance—which is through the still-liquid metal of the flange. At the moment of solidification the gas which is still passing is trapped, and the holes found afterwards are the result.

When the core is responsible for excessive gas generation—greater than the vents can cope with—which may easily occur in a very thin oil-sand core which is insufficiently baked—the effect is as shown in Fig. 16. This represents a bulkhead piece. As soon as the flange was machined, the large cavity was disclosed in the top half of the end flange. Fig. 17 shows the top half of the casting after sawing through on the plane of the mould joint. The core in this case was 9 in. long and only $\frac{1}{2}$ in. diameter, and it is apparent that the small vent being unable to carry off the rush of gas, and a pressure consequently developing, this has released itself by bubbling through the still-liquid metal of the flange, where it was eventually trapped on solidification.

Fig. 11.—The Connecting Rib between Two Heavy Sections is Torn.

Consideration of "Burning On"

For some reason the term "burning on," by which is meant the welding or repairing of a casting by the application of molten metal of the same composition, is only spoken of in foundries with bated breath and in hushed whispers. There seems to be some stigma attaching to the process which renders it necessary to refer to it covertly, and only after glancing around to make sure that no one is overhearing. The origin of this attitude probably dates back to the dim and distant past when the process was resorted to by some unscrupulous persons to enable castings to be accepted which might otherwise be rejected, this being accomplished by carefully "burning on" previously-prepared special test-bars. Everyone has heard stories of this kind, and such stories, whether substantiated or not, appear to have brought the process of "burning on" into disrepute. However, in these enlightened times it is not necessary for anyone to resort to such malpractices to meet even the most stringent specification. It is time, therefore, to rid ourselves of all prejudice in the matter, and examine the process and results.

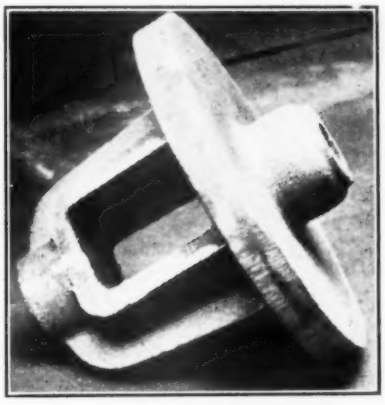


Fig. 12.—Valve-Lid Casting.

If the results indicate that it is possible to make a repair which is as sound and strong as the rest of the casting, and without any detriment to the future life and working of the casting, then it is time to accept the process as a definite foundry operation, and allow its use where necessary. After all, there are many quite legitimate occasions where it may be used with practical and economic advantage, and it is desirable to clear it of the suspicion and distrust which surround it.

It should be realised that it is possible to make a "burn" which is a perfect weld, and which is virtually one and the same with the metal of the casting. This point can easily be proved by taking sets of duplicate gunmetal test-bars.

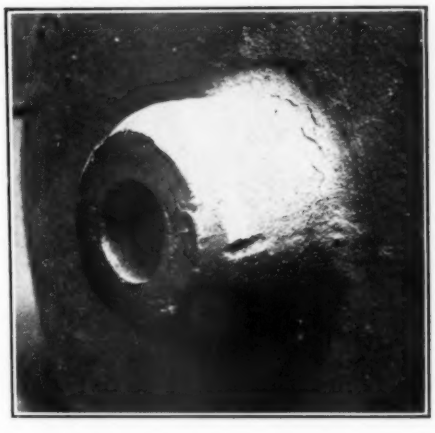


Fig. 13.—Shows where Defect was found.

One of the pair can be machined and tested "as-cast." The other can be cut in two equal portions and then "burned" together again. If correctly "burned," it will be found to give almost equally good test results, compared with the original bar. Usually the Brinell hardness is

increased at the area where the "burn" has been carried out.

	Original bars.	After cutting and rejoining.
Tensile ..	19.4 tons per sq. in.	18.4 tons per sq. in.
Elong. ..	24 per cent.	15 per cent.
Brinell ..	85	95

At the same time, it must be admitted that under bad conditions, and with careless manipulation, unreliable results may be obtained, so that in every case, where the "burning up" of an important casting is contemplated, the purchaser or user is entitled to know and accord his sanction beforehand.

It must be admitted that the "burning" together of a simple sectioned test-bar does not give results which can be interpreted as being representative of what may occur in a casting. Where a casting is complicated or of unequal section, definite stresses will be set up when "burning" is attempted. The sudden heating up of local areas with the corresponding sudden expansion, which is resisted by adjacent non-expanded cold areas, may result in a stress of sufficient magnitude to cause a crack. Then, indeed, the case is hopeless. The remedy—or, rather, the way to circumvent this happening—is to preheat the whole costing. There is a limit to what can be done in the way of preheating, especially if the casting is of considerable mass: so that the majority of castings start with a severe handicap in this respect. At the conclusion of the "burning-on" process, the casting is usually covered up with sand and left to cool out undisturbed. If, when the casting is disinterred, the "burn" appears to be a proper weld, and is sound, and the casting is still all in one piece, the foundryman usually calls it a good day's work, and is satisfied. But this, it should be pointed out, is being just a little optimistic. How does the foundryman know that, although the casting is still in one piece, it may yet be in such a state of internal stress that it is almost cracking? How can he be certain, for instance, that on putting it into service the extra working stresses, especially where accompanied by heat, may just be sufficient to carry it over the borderline and cause the costing to break down? It is certain that quite a number of cases of breakdown of this kind have occurred when castings which have been "burned" have been put into service. The breakdown may not occur immediately, but may only take place after a period of service.

It has been admitted that it is seldom possible to heat the casting sufficiently before "burning," to ensure reasonable freedom from stress on the completion of the process; but there is nothing to prevent the casting being annealed afterwards to remove any residual stress. Annealing at a temperature of 700 to 750 deg. C. for a short period, followed by a reasonably slow cooling, should be all that is sufficient to give a casting (providing the "burning on" has been done correctly, and it is a sound weld) which is as good as a sound original casting. If this practice became universal, there would then be no more prejudice against the process of "burning on."

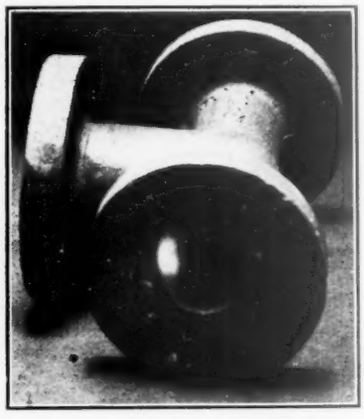


Fig. 14.—Shows Wormhole Type of Defect.

Fig. 15.—Defect extending through Fillet into Flange.

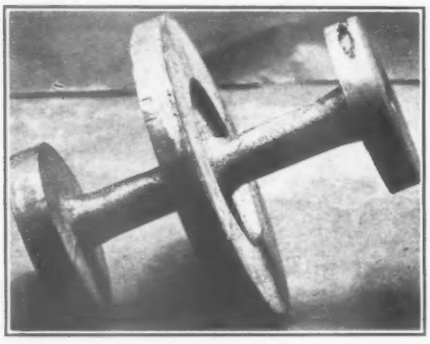


Fig. 16.—A "Core Blow" has caused this Defect.

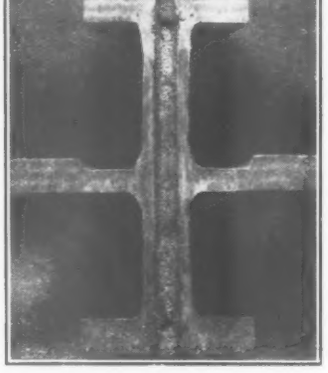


Fig. 17.—Shows Top Half of Casting after Sawing through the Plane of Mould Joint.

It should be remembered that any non-ferrous casting which has been "burned up" has, to the eye of the metallurgist, the word "burn" written upon it until the day it ceases to be a casting. In other words, once a casting has been "burned up," the evidence is there for all time. Even annealing, whilst it removes the internal stress, and changes the inner micro-structure of the crystal, does not cause a recrystallisation, and the new crystal arrangement caused by the burning process remains. Fig. 18 illustrates an experimentally-burned casting, whilst Fig. 19 shows a section of a casting which was repaired by the burning-up process for experimental purposes. Fig. 20 shows a macro-etching of a slice cut from the casting. The casting successfully withstood the normal pressure test, but was cut up for examination. The perfect junction of the added metal with the material of the original casting is shown in the photo-micrograph (Fig. 21). As far as actual physical strength is concerned, it can be accepted that, where the burning has been carefully done, the welded portion will have equal, if not greater, strength compared with other parts of the same casting, and assuming the casting has been suitably annealed, no fear as to its future need be entertained.

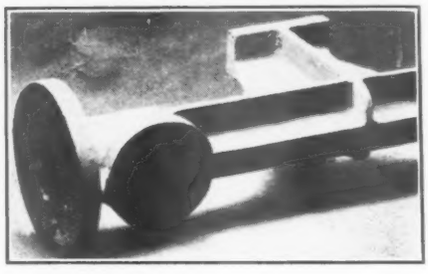


Fig. 18.—An Experimentally-Burned Casting.

Fig. 19.—Casting after being Burned-on.

Necessity for Standardisation

If one considers the four metals—copper, tin, lead and zinc—and remembers that it will be possible to alloy them (with the exception of lead) in proportions ranging from 1 to 99.9 per cent., it will be appreciated that the number of possible combinations is tremendous. This does seem to have been realised by the chief engineers, designers, consultants, etc., of all the firms who buy non-ferrous castings; and a perusal of representative specifications shows an amazing collection of alloys (literally running into hundreds), many of which vary only by half-percents. To the average non-ferrous foundry, this may not be a serious matter, as, if the foundry

is only making for its own particular engineering department, it may only be called upon to cast one or two alloys which have been adopted and more or less standardised by the particular firm. Where, however, the foundry is producing castings to outside orders for a number of firms which each specify the particular alloys which they require (and not only specify, but see that they get them), then the number of slightly

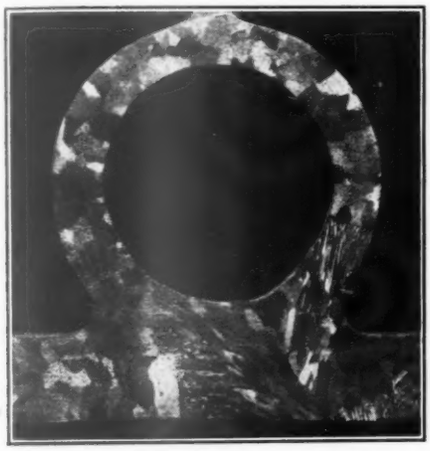


Fig. 20.—Macro-Etching from the Repaired Casting.

varying compositions in use at the same time, with the necessity for careful control and segregation of the various mixtures and returns, involves a considerable amount of extra work and expense. The ridiculous and uneconomic aspect of the question is fully appreciated when it is realised that the various compositions are all for the same or similar purposes, and it does not take long for the non-ferrous founder to realise that some standardisation is urgently required. Leaving out of the question the range of light alloys and special compositions for specialised services, non-ferrous castings are used by the designer for general constructional purposes where strength and pressure tightness without brittleness is desirable. These conditions are met by alloys of the gunmetal-bronze class—alloys of copper, tin and zinc, with possibly some lead. Where a constructional part is also called upon

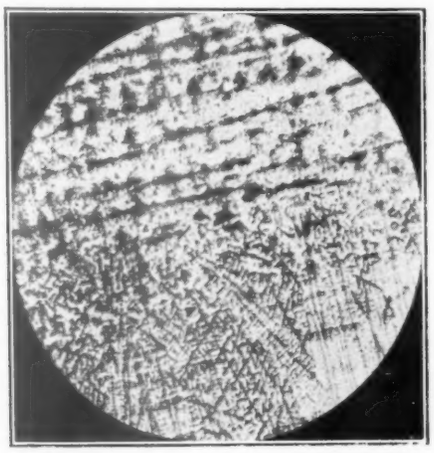


Fig. 21.—A Perfect Weld effected by Burning-on.

to possess wear resistance, something in the phosphor-bronze range is indicated. It is no secret that the Non-Ferrous Sub-Committee of the Technical Committee of the Institute of British Foundrymen have under consideration the preparation of a range of standard gunmetals and a range of standard phosphor-bronzes. If these are eventually approved and accepted by the B.S.I. and adopted by industry generally, it is considered that the majority of the weird assortment of alloys in private specifications could be abolished, with very great saving and benefit all round. This, when it materialises, will be a very big achievement with far-reaching practical results, and is deserving of all the consideration and support it can get.

Sand Control

Sand and sand control has been briefly referred to earlier. One of the great difficulties in the past has been the lack of suitable apparatus for sand testing. Anyone who wished to investigate sands had first to more or less devise some form of apparatus. The result was that it was very difficult to compare one set of published results with any other set of results.

The Sands Sub-Committee of the Technical Committee have spent a considerable amount of time getting together a suitable set of standard sand-testing apparatus, and this is now available. This is a very practical and quite robust apparatus, and a laboratory is not essential for its use. It is suggested that every progressive foundry should have a set of this apparatus and carefully check the properties of the sand in use for each purpose. Systematic use over a period of normal good working would yield a set of figures which could be taken as a basis. Any departure from these figures will then indicate some irregularity which should be accounted for. In this way it should be possible to cut out guesswork and work to standard conditions; in addition, it will probably be found that the use of the apparatus will indicate ways in which a saving can be made.

Favourable Nickel Prospects

By "Onlooker"

The sensational advance recently witnessed in the shares of the International Nickel Company is an indication of the faith which investors have in the future of nickel, for, although it is true that the company mentioned is also a producer of copper, the principal reason for speeding up output is to be found in the fact that world demand for nickel to-day is on a scale greater than for many years past.

In spite of the fact that the metal under discussion ranks with tin as being among the comparatively high-priced commodities, consumers do not seem to be in any way deterred by this fact from using it. Certainly, compared with copper at £36, lead at £12 and spelter at £16, a quotation of £220 for nickel seems pretty stiff, but it must be remembered that the world's known sources of supply are limited, and that, unlike the metals mentioned, which are located more or less all over the face of the globe, reserves of nickel are concentrated mainly in one place, viz., Canada. A certain tonnage is, it is true, forthcoming from New Caledonia, but this does not amount to a great deal.

The popularity of nickel has grown very much during the post-war years, and its remarkable physical properties have brought it to the front in many directions to which it had previously been a stranger. In pushing the fortunes of their product the nickel producers have undoubtedly been considerably assisted by the fact that the price of this metal is remarkably stable, and during a period when fluctuations in the value of commodities have been such as to disturb very seriously the world of commerce, all concerned with nickel have been able to go forward in the safe and certain assurance that the value of their purchases would not suffer any abatement. Happily, free too from the ups and downs brought about by speculative operations, the nickel market is one in which buyers feel that they can operate with complete safety.

Reference has been made above to the marked increase in the demand for nickel, and at the moment it looks very much as if the rate of world consumption is back to the level of 1929, viz., 68,000 short tons for the twelve months. By 1932 the total annual tonnage of nickel going into consumption had declined to 28,500 tons, but last year pulled up to 48,000, an increase of close on 60 per cent., a most heartening improvement. A very marked change for the better came during the last quarter of 1933, and sales of nickel so far this year have been on a scale surpassing expectations entertained on January 1. This upward movement in the sales curve is doubtless due to the increasing volume of world trade, but too much emphasis cannot be laid upon the excellent work done by the Bureau of Information on Nickel in opening up new markets for this metal.

During the past decade rapid progress has been made in the use of nickel alloyed with iron and steel, and at the present time the activity in the motor-car industry is proving of considerable benefit to the nickel producers. Another direction in which of recent years this metal has come to the front is in copper-nickel alloys, one instance of this use being condenser tubes, which have to a great extent supplanted 70/30 brass. The employment of nickel for plating is, of course, well known, and here again better trade is bringing an increase in demand.

World production of nickel in 1932 reached the low point of 22,000 short tons, the decline to this level being progressive from 1929, when the total exceeded 60,000 short tons, but last year saw the rate of production moving up again, and 1934 will see a further marked improvement over 1933. The outlook for nickel certainly seems to be distinctly favourable.

Creep of Metals Using a Modified Rohn Test

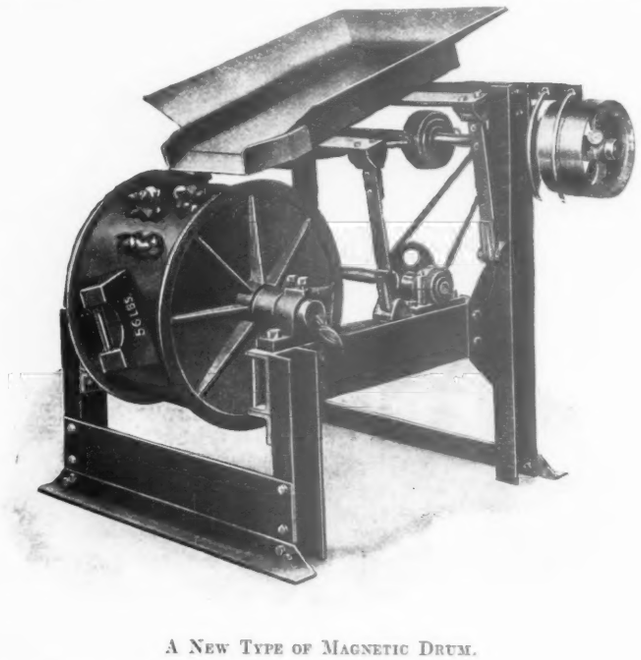
Messrs. C. R. Austin and J. R. Gier recently read a Paper before the American Institute of Mining and Metallurgical Engineers on "Comparative Studies on Creep of Metals using a Modified Rohn Test" in which:—(1) Data have been presented on elementary metals and commercial alloys to illustrate how the temperature-time curves, obtained by means of a modified form of the Rohn test and resulting from plastic deformation, serve as a ready means of making comparisons of the creep characteristics of metals at elevated temperatures. (2) A convenient means of classification has been discussed whereby an approximate relationship is expressed between load-carrying capacity and temperature for any given metal. A series of curves for iron, nickel and cobalt illustrates this method of sorting metals. (3) The relationship between rate of creep and temperature with the four loads studied for iron, nickel and cobalt indicates that the rate of creep increases much faster than temperature. This accords with general observations on effect of temperature on creep rate. (4) The effects of minute amounts of plastic deformation on resistance to further creep have been studied. The importance of these effects on the *modus operandi* of test have been discussed, and it has been shown that they tend to assume minor importance in the higher temperature ranges. (5) In order to express the deformation-time data on the commercial alloys in terms readily understood by those associated with results obtained by the conventional constant-temperature method, the data have been expressed in a series of curves illustrating the relationship between creep rate and temperature of test for constant load. Variation in load is represented in the different curves. In discussing the evaluation of the high-temperature strengths of the alloys, the importance of initial amount of deformation on creep rate has been realised and taken into account. (6) The information and analysis of data presented in the Paper appear to substantiate the contention that this modified Rohn method of testing provides a valuable means of studying the high-temperature properties of materials.

XUM

A New Type of Magnetic Drum

The difference between a magnetic pulley and a magnetic drum is that in the former case the magnets rotate, whereas in the latter the magnets are fixed and the drum rotates around them.

Magnetic pulleys have been manufactured for about fifty years, and they have gradually improved; notwithstanding, pulleys made on the generally-accepted principle of recent years have always had a weak feature—" the neutral " zone which definitely exists between the poles. As this zone is vertical it will be readily realised that a piece of iron which happens to be lying on that section of the feed belt running over the " neutral zone " is likely to fall off into the " cleaned " material. They are largely used in the foundry for preventing tramp-iron from contaminating the sand, hence the missing of a piece of iron may damage a mould or the impellor of a sand-slinger.



A New Type of Magnetic Drum.

The Rapid Magnetting Machine Company, Limited, Lombard Street, Birmingham, who have been manufacturing magnetic pulleys for 30 years and definitely claim to be the British pioneers of magnetic separation, have at last produced a magnetic pulley without a neutral zone. The significance of this will be the better appreciated by the following:—

A typical magnetic pulley, 16 in. dia., was taken for the test. A 1-in. cube of mild steel was placed against the neutral zone and it fell to the ground.

The same cube was placed in the corresponding position on a " Rapid Biflux " pulley of the same diameter with exactly the same windings, and the testing instrument registered a " pull " of 12 lbs. before it was pulled off.

In order that the test described may be given its proper value and be properly appreciated, it should be understood that a " pull " exerted by a magnet varies inversely as the square of the distance between the magnet pole and the armature (or piece of iron being attracted).

In the case of a magnetic pulley, however, the decrease in " pull " due to the leakage of the magnetic flux between poles instead of passing through the armature is very considerable and substantially reduces the attractive " pull " of the pulley.

For example, the " pull " exerted on an armature placed against the magnet pole of a given pulley was 70 lbs., whilst interposing a piece of feed belt only $\frac{3}{16}$ in. in thickness between the pole and the armature reduced the pull to 24 lbs. —a decrease of 66 per cent., with consequent loss of efficiency of extraction for small pieces of iron. A thicker feed belt would naturally show a still greater decrease.

It now becomes clear that in the " Rapid Biflux " there is a remarkable improvement by eliminating the neutral spot, and this is accomplished without adversely affecting the " penetrating " field.

For applications such as the separation of iron from non-ferrous turnings, from moulding sand, and similar purposes, the magnetic drum has had a large use, but the problem of separating out large and heavy pieces of " tramp iron," *i.e.*, pieces varying in weight from 1 lb. to perhaps 20 lbs., by means of a magnetic drum has hitherto not been solved; there has never been any difficulty in making a magnetic drum capable of attracting pieces of " tramp iron " weighing many pounds—the difficulty has been, having attracted it, to drop it automatically. Obviously if it would not drop off it could not be brushed or even scraped off.

Had this been possible the magnetic pulley would never have reached the popularity it attained. This can be better realised if one takes into consideration the example quoted above, when, by interposing a piece of feed belt only $\frac{3}{16}$ in. thick, the " pull " was reduced by 66 per cent.

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The magnet coals are sealed in a metallic cover. The outer casing of thick metal to withstand for a long period the wear of material of an abrasive nature is composed of sections which can be readily replaced without dismantling the drum.

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Modern Foundry Practice*

MECHANISATION AND EQUIPMENT

By Vincent C. Faulkner

Mechanised foundries aim at the synchronisation of the major portion of the following operations:—(1) The provision of a continuous supply of cool general-purpose sand; (2) means for the rapid manufacture of moulds and cores; (3) means for returning any spilt sand back to the sand supply; (4) means for returning any surplus sand back to the source of supply; (5) means for taking the sand knocked out from the boxes back into the system; (6) means for introducing new sand and coal dust into the system; (7) means for taking away the rammed boxes from the moulding boxes to the pouring station; (8) means for taking the empty boxes back to the moulding stations; (9) means for bringing up the cores to the moulders; (10) means for bringing up the molten metal; and (11) means for taking the finished castings away from the knock-out stations to the fettling department. Thus a modern mechanised foundry involves the synchronisation of a dozen or more conveyors and elevators of varying types.

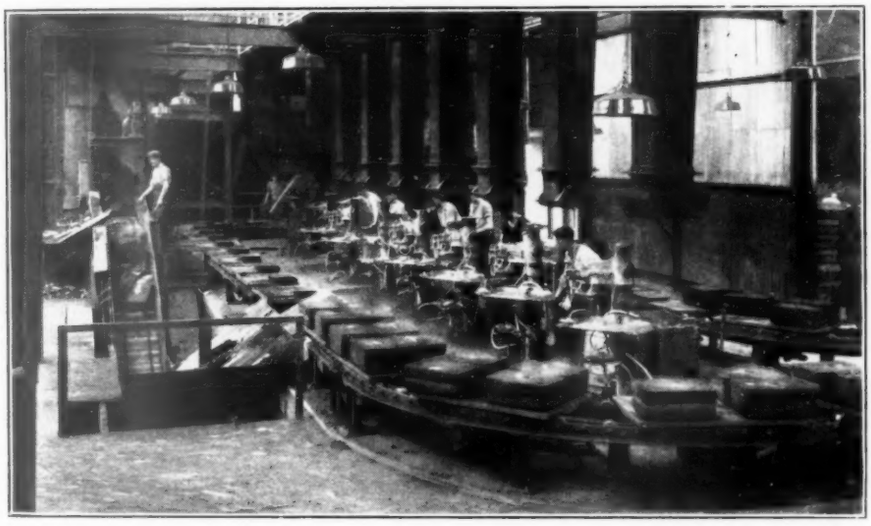

Fig. 1.—Typical Example of Model Continuous-Casting Plant.

Sand Supply

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The Knock-out

An infinite amount of thought is now being directed towards the improvement of facilities in what is admittedly the most disagreeable section of the whole plant. Where the ratio of metal to sand is low and the moisture content of the system sand reasonably high, no difficulty is experienced, but where many cores are incorporated as in the manufacture of radiators, automobile cylinders and pipe bends, then the dust problem arises. This is normally overcome by installing a hood which mechanically exhausts to atmosphere. Too strong a draft causes considerable loss in the coal-dust content of the sand, whilst insufficient draft gives rise to distinctly-disagreeable working conditions. In France and the United States it is usual to employ coloured labour for that particular job.

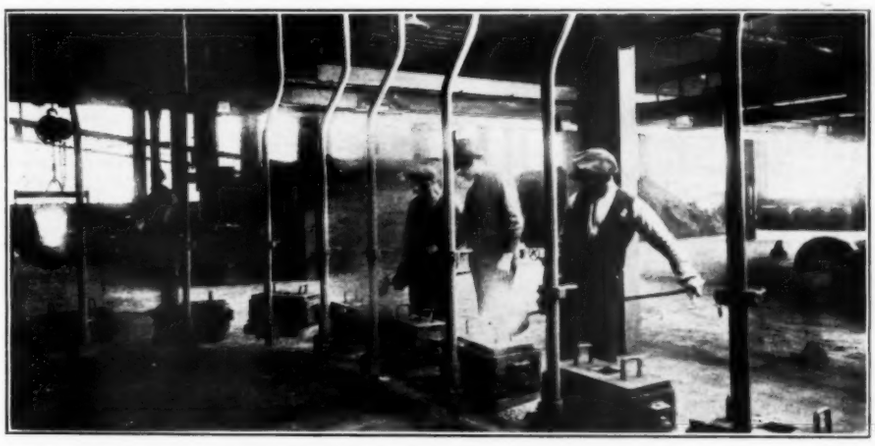
An efficient knock-out in Great Britain is installed at the works of the Midland Electric Manufacturing Company, where the table of the mould conveyor tilts at a given point to project the boxless mould containing the still hot casting on to an apron conveyor, which allows a travel of some feet before the casting is picked off by the labourer. At the Crane Company's works the moulds, also boxless, are placed upon one of four merry-go-rounds, from which they are pushed off on to an apron conveyor situated about 1 ft. below ground level. This conveyor carries the sand and castings up a height to the uppermost level. They are then ploughed off on to a sloping grate, which separates the sand from the castings. The latter are then forked off into appropriate bins. Other systems involve a lifting of the moulding boxes by air hoist on to grates, which are jarred by a simple cam action.

Introduction of New Sand and Coal Dust

One of the most popular methods of introducing new sand and coal dust into the system is to install over the conveyor belt, taking the sand from the knock-out surplus and spill, two hoppers provided with rotating circular-plate bases which continuously spill fresh supplies into the system. A simpler means which is adopted by some of the largest automobile foundries is to place on each cast-up mould, a predetermined amount of new sand and coal dust.

Mould Conveyors

Mould conveyors are generally of two types (omitting merry-go-rounds). One—the more popular, consists of a series of low tables or bogies connected by chain which forms a complete circuit around the moulding station. The tops of these are preferably made of cast iron, as steel, through repeated spilling, warps. The table tops are usually grooved to allow air to pass through, presumably to aid venting. The second type, more popular with the automobile foundries, is the pendulum conveyor. This perhaps is preferable, as it lends itself better to directional change, and moulds can be taken up to the roof, if necessary, and so permit transport to be carried on beneath it. Quite often, immediately after being cast up, the moulds travel for a considerable distance beneath a fume-exhausting hood in order to keep the foundry atmosphere more congenial. Moulding boxes are normally, but not invariably, taken back to moulders by the mould conveyor.



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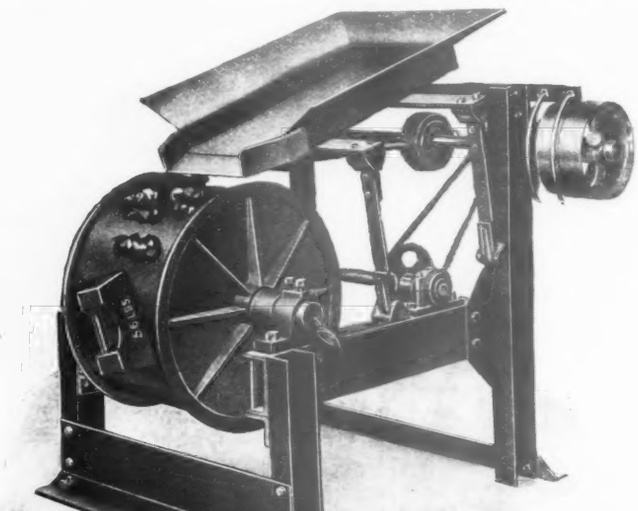
A New Type of Magnetic Drum

The difference between a magnetic pulley and a magnetic drum is that in the former case the magnets rotate, whereas in the latter the magnets are fixed and the drum rotates around them.

Magnetic pulleys have been manufactured for about fifty years, and they have gradually improved; notwithstanding, pulleys made on the generally-accepted principle of recent years have always had a weak feature—" the neutral " zone which definitely exists between the poles. As this zone is vertical it will be readily realised that a piece of iron which happens to be lying on that section of the feed belt running over the " neutral zone " is likely to fall off into the " cleaned " material. They are largely used in the foundry for preventing tramp-iron from contaminating the sand, hence the missing of a piece of iron may damage a mould or the impellor of a sand-slinger.



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The Rapid Magnetting Machine Company, Limited, Lombard Street, Birmingham, who have been manufacturing magnetic pulleys for 30 years and definitely claim to be the British pioneers of magnetic separation, have at last produced a magnetic pulley without a neutral zone. The significance of this will be the better appreciated by the following:—

A typical magnetic pulley, 16 in. dia., was taken for the test. A 1-in. cube of mild steel was placed against the neutral zone and it fell to the ground.

The same cube was placed in the corresponding position on a " Rapid Biflux " pulley of the same diameter with exactly the same windings, and the testing instrument registered a " pull " of 12 lbs. before it was pulled off.

In order that the test described may be given its proper value and be properly appreciated, it should be understood that a " pull " exerted by a magnet varies inversely as the square of the distance between the magnet pole and the armature (or piece of iron being attracted).

In the case of a magnetic pulley, however, the decrease in " pull " due to the leakage of the magnetic flux between poles instead of passing through the armature is very considerable and substantially reduces the attractive " pull " of the pulley.

For example, the " pull " exerted on an armature placed against the magnet pole of a given pulley was 70 lbs., whilst interposing a piece of feed belt only $\frac{3}{16}$ in. in thickness between the pole and the armature reduced the pull to 24 lbs. —a decrease of 66 per cent., with consequent loss of efficiency of extraction for small pieces of iron. A thicker feed belt would naturally show a still greater decrease.

It now becomes clear that in the " Rapid Biflux " there is a remarkable improvement by eliminating the neutral spot, and this is accomplished without adversely affecting the " penetrating " field.

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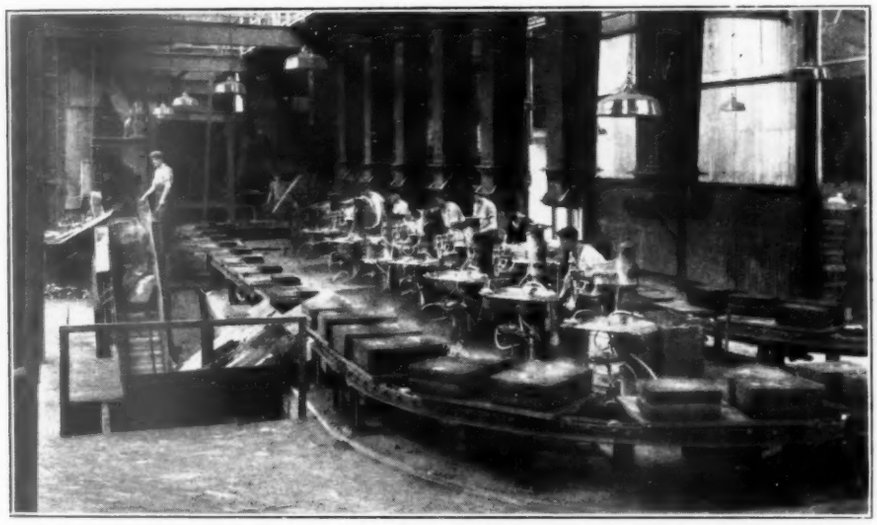

Fig. 1—Typical Example of Model Continuous-Casting Plant.

back into the system; (6) means for introducing new sand and coal dust into the system; (7) means for taking away the rammed boxes from the moulding boxes to the pouring station; (8) means for taking the empty boxes back to the moulding stations; (9) means for bringing up the cores to the moulders; (10) means for bringing up the molten metal; and (11) means for taking the finished castings away from the knock-out stations to the fettling department. Thus a modern mechanised foundry involves the synchronisation of a dozen or more conveyors and elevators of varying types.

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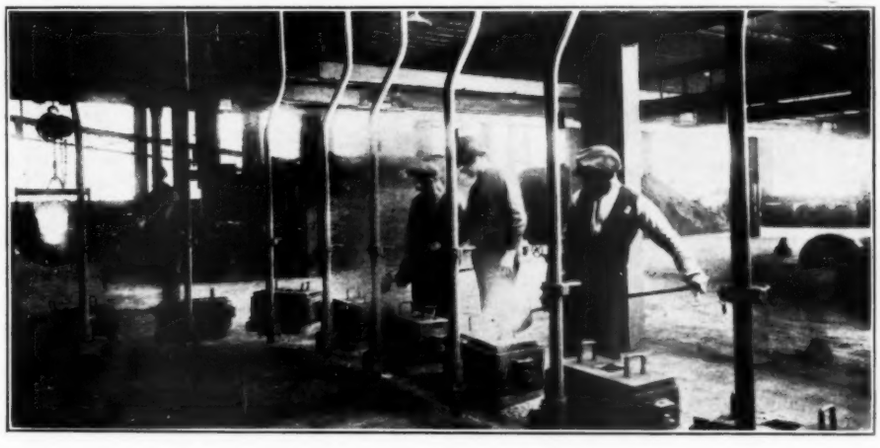

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among the coremakers, and so transport the cores through the drying stoves, where they are baked at 220 deg. C., then continue at a speed consistent with the best cooling rate and also to facilitate inspection. Spraying or even immersion in blacking may be done before finally reaching the mould assembly.

Castings Conveyor

There is a choice of types of conveyor for castings. Ferranti, for instance, uses an apron-belt conveyor which, moving slowly, allows time for the removal of runners and risers, inspection and automatic counting, grinding, and finally delivers to the machine shop. The automobile foundries favour an overhead chain conveyor carrying hooks on which the castings are suspended and zig-zagged around for about a quarter of a mile or so in order to cool the castings prior to dressing. The radiator foundries also utilise the same system, but, *en route*, castings encounter a series of vertically-disposed plates, so spaced that a series of heavy blows are communicated to each segment, so that the core sand is removed from each. In this way 90 tons of sand leave the foundry each working day to fill up a disused dock.

The third system is to utilise an ordinary gravity conveyor at waist height. The smaller castings are placed into trays. This is the system used by such high-grade firms as Harpers, of Willenhall, as it allows individual attention to be given to each casting without speed being dictated by the conveyor.

Fig. 3.—Modern Fettling Shop for Light Engineering Castings.

Follsain Metals Limited

Follsain Metals, Limited, has been registered with a capital of £50,000 to enter into an agreement with the Wycliffe Foundry Company, Limited, and the Follsain Syndicate, Limited, and to carry on the business of smelters, ironmasters, engineers, etc. The capital is in 1,000,000 shares of 1s. each, of which 750,000 shares (525,000 to the Follsain Syndicate and 225,000 to Wycliffe Foundry) are to be issued as fully paid as consideration for benefits relating to patent rights. The business to be taken over commenced in a commercial form in June, 1933. Five material contracts are mentioned in the statement in lieu of prospectus, the parties including H. Orkin, L. and N. Sainderichin, A. Folliet, Ferrofollsain Syndicat and Thermofollsain Syndicat. The directors are: Heyman Orkin, director of Follsain Syndicate, Follsain Syndicate (France) and the Wycliffe Foundry Company; Wm. H. W. Proctor, managing director of Wycliffe Foundry Company; and Guy Barrett. The registered office is at Halifax House, 62-4, Moorgate, London, E.C.

Temperature Control

A meeting of the Scottish Branch was held in the Royal Technical College, Glasgow, on February 10. Mr. J. Currie, Branch-President, was in the chair.

The Chairman said that it was his pleasure to introduce Prof. Hay, the Professor of Metallurgy in the College, who had always shown a great interest in the work of the Institute, and who had come to give them a Paper on "Temperature Control in Metallurgical Practice." The subject was one of very great importance to them as foundrymen, whether they were engaged in steel, cast iron or non-ferrous work.

Prof. Hay said, in the course of the lecture, that temperature control was a vital necessity in modern metallurgical work, and some consideration had to be given to the type of recording apparatus to be installed. The directors of works would naturally ask, is value to be obtained from the installation of a pyrometric outfit? The answer to that question was, it all depended upon the use that was made of the apparatus.

Some of the more commonly-used methods of measuring temperature were described and discussed, and the principles on which they worked were explained in detail. Various systems of thermo-couple were touched upon, and a series of curves showing the E.M.F. given by the different couples with increasing temperatures were shown.

The protection of the thermocouple from furnace gases was discussed and the influence of thick metal sheaths in causing a time lag was pointed out. The lecturer referred to the new carbon-silicon-carbide thermocouple which has been developed in America recently. He showed slides illustrating its construction and of its capabilities. He explained that this couple had been used with success in determining the temperature of liquid pig-iron and also of open-hearth furnace-tapping temperatures. It was stated that about eight readings could be made with the couple before it was too seriously attacked by the metal bath, but by means of a rapidly-replaceable screwed carbon tip for the end of the outer carbon rod, this drawback could be overcome. Various types of optical pyrometers were described and the advantages and limitations of each discussed. A number of pyrometers were exhibited, and the manner of using them described. The importance of temperature control was discussed from various standpoints.

The effect of temperature on the solubility of gases in metals was illustrated from the work of Sieverts and Iwase. If a molten metal was capable of dissolving increasing quantities of gas with increasing temperature then on solidification the gas must be given off. If cooling is too rapid to allow of the easy escape of the gas, then blow-holes and spongy spots will result. Reference was made to the recent work by Bardehauer and Bottenberg in which it was shown that dissolved gases played an important part in the volume changes which occur during solidification. They also showed that melting temperature greatly influenced the amount of gases which molten cast iron could dissolve. Molten cast iron appeared capable of dissolving about four times its own volume of gas at 1,500 deg. C., which is well above the saturation quantity on solidification. The gas content in grey irons appeared to decrease if the metal was kept in the molten condition for some time. Tests on the effect of remelting of a grey iron at 1,320 deg. C. showed that the gas content and solidification expansion were progressively diminished by each melting.

The effect of temperature upon the velocity of reaction was discussed and reference was made to the recent work of Allan upon the soundness of copper castings. He showed that the unsoundness was increased by increasing temperature and that very slow cooling during solidification allowed of the evolution of gas and produced sound ingots. The effect of temperature upon dissociation was next dealt with and curves showing dissociation pressures of cuprous oxide and nickel oxide with increasing temperatures were shown.

The work of McCance on the deoxidation of liquid steel and the influence of temperature upon such deoxidation was also mentioned. The importance of casting temperature was shown by experiments upon cast iron, gunmetal and aluminium-copper alloys, mechanical properties being given for different casting temperatures. This subject was also illustrated from the casting of bearing metals, a series of photo-micrographs showing the effect of casting temperature upon the size and distribution of the constituents. Further applications of pyrometric control were given from the heat-treatment and ageing of aluminium, iron-copper alloys and some of the special steels.

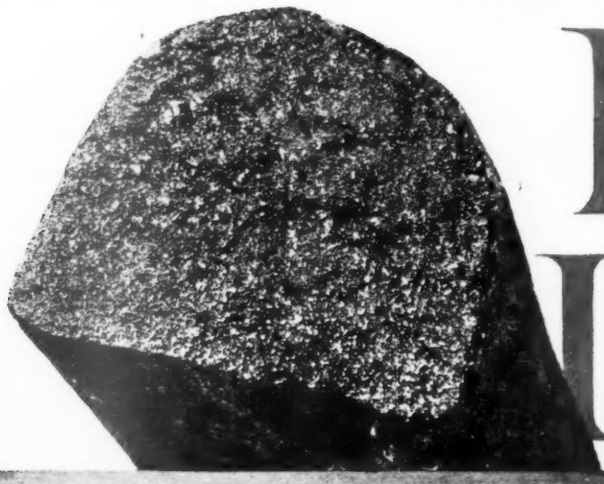
Notes from I.B.F. Branches

Burnley Branch.—The March meeting and annual election of officers of the Burnley Section of the Institute of British Foundrymen was held in the Municipal College, Burnley, on March 6, 1934. The following officers were elected:—President, Mr. F. Harris, Padiham; Senior Vice-President, Mr. L. Wharton, Colne; Junior Vice-President, Mr. J. Lowe, Accrington. Council, Mr. C. Tate, Mr. J. Cross, Mr. J. Richardson, Mr. H. E. Robinson, Mr. J. Jackson, Mr. W. Haworth, Mr. J. Duckworth, Mr. E. L. Winter and Mr. H. Meadowcroft. Hon. secretary, Mr. J. Pell.

A vote of thanks to the retiring officials was moved by Mr. J. Jackson and seconded by Mr. J. Lowe. After the election of officers, Mr. John Jackson, of Accrington, gave a short Paper on the "Annealing of Castings." Afterwards, Mr. J. Taylor proposed, and Mr. J. Hogg seconded, a vote of thanks to Mr. Jackson, to which he replied. An excellent discussion followed.

Rails for China

The Chinese Government Purchasing Commission has placed in this country two orders for rails—10,000 tons for the Canton-Hankow Railway and 7,000 for the Shantung Railway—to be delivered at Hankow not later than June. These orders are divided between Messrs. Dorman, Long & Company, Limited, and the Cargo Fleet Iron Company, Limited.



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Manufacturers of FOUNDRY, BASIC and HEMATITE qualities. Delivery from stock.
Booklet giving analyses, etc., will be sent on request.
DORMAN LONG & CO. LTD., MIDDLESBROUGH

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"The brand of proved reliability"

Supplied to specifications covering a wide range of requirements and employed by the leading Railway Co's Roll Makers and Engineering Founders.

WARNER & CO. LIMITED

CARGO FLEET MIDDLESBROUGH

This Week's News in Brief

Trade Talk

Messrs. the British Piston Ring Company, Limited, have ordered from Stein & Atkinson, Limited, a 1-ton Stein rotary furnace for their iron foundry.

The Atholl Steam Laundry, Pitlochry, Perthshire, of Messrs. T. Muir & Sons, has installed an additional calender machine of the newest type, at a cost of £1,000. supplied by Messrs. D. & J. Tullis, Limited, Clydebank.

Employees of Messrs. Duncan Stewart & Company, Limited, London Road Iron Works, Glasgow, have contributed £169 to infirmaries and local charities. The employees of the Cyclops Foundry & Patternmaking Company, Limited, Glasgow, have contributed a sum of £19 for similar purposes.

It is an interesting fact, though possibly merely a coincidence, that during the week in which the measure was passed to reduce the gold content of the Czecho-Slovak crown with a view to giving an impulse to trade, quite a number of important orders reached the Czech industries from abroad. The Brno Machinery Company, which recently secured very important contracts for South America, has now received a 50,000,000-crown order from China.

Considerable interest was shown in the launch of the "Arcgow" from the yard of Messrs. Lithgows, Limited, Port Glasgow, for Sir Joseph Isherwood & Company, Limited, London. The new vessel is of the single-deck type and is 360 ft. in length, with a deadweight carrying capacity of 7,000 tons on a load draft (summer freeboard) of 22 ft. 7 in. The machinery and boilers are being supplied by Messrs. David Rowan & Company, Limited, Glasgow.

Considerable damage was caused by an outbreak of fire on Saturday night in the Sunnyside Foundry, Camelon, Falkirk. The blaze originated in a gas-stove-testing room adjoining the main warehouse. The flames had secured a firm hold when the fire brigade arrived, and the testing room was almost completely destroyed, while articles in the warehouse were also considerably damaged. The firemen had to guard against the danger of an explosion through so many gas jets being operated in the test room.

At the annual general meeting of the North British Locomotive Company, held last week, the chairman, Sir Hugh Reid, Bt., after reviewing the present position of the industry, indicated how much the Government had assisted, directly or indirectly, other industries during the period of depression, and how remarkable it was that the locomotive industry, which had in the past contributed so much to the prosperity of the country and to providing high-class employment, had so far been left unaided by the State to struggle along in international competition for contracts.

Visitors who saw the new working model of the Stanton-Wilson self-adjusting pipe joint at the British Industries Fair, Castle Bromwich, will be interested to learn that during the Fair the vibrating joint made 3,696,000 movements. The joint was used to couple two Stanton-Delavaud spun-iron pipes, which were continuously vibrated in order to demonstrate the effects of traffic vibration on gas and water mains. The Stanton Ironworks Company, Limited, state that the joint maintained the initial air pressure throughout the test, and did not once have to be tightened, re-made, or pumped up.

With an all-round improvement in the coal, iron and steel industry in the town, unemployment figures have dropped considerably in Motherwell. Over 2,000 more workers are employed than at the same period last year. The coal trade has improved greatly, while not for many years has business been so active in Motherwell steelworks. Owing to improved conditions at Messrs. Colville's Dalzell works, three shifts per day are operating at No. 4 bar mill. The firm is busy on several foreign orders, and has an order for 3,000 tons of steel rails for the New Zealand Government Railways. More men are employed than for many years past, and a works official recently indicated that still more men would be taken on before the Fair holidays.

The report of the directors of the Lancashire Steel Corporation, Limited, states that the development of the Irlam Works is now nearing completion, the rolling-mill equipment having been enlarged and brought into conformity with modern practice. The new wire-rod rolling mill was put into operation during the year with satisfactory results. The directors are satisfied that the plant at Irlam is now an efficiently organised unit for the conversion of raw materials into the finished product. An interest in the business of William Robertson, Limited, bright steel-bar and wire manufacturers in Warrington, has been acquired. The quarry at Borfari, North Wales, ceased to operate during the year owing to falling off in the demand for its product. The output of the various works during the year showed an increase over the output for the previous year.

Another ancient church bell has just been successfully repaired by modern welding methods. It belongs to Blythburgh Church, Suffolk, and was cast in 1608 by James Edbere, whose name appears in the inscription. The bell is interesting to engineers as an example of early foundry work, and shows how successfully large castings were made over 300 years ago. The bell stands 3 ft. 6 in. high and weighs about 8 cwts. It was a condition of the order to the welding engineers, Messrs. Barimar, Limited, of 14-18, Lamb's Conduit Street, London, W.C.1, who carried out the repairs, that under no circumstances were the handsome canons on the bell to be removed during the process of repair, and this stipulation was faithfully observed. The cracks were due to the development of rust around the iron clapper staple in the crown, but the welding engineers removed this staple, and there is now no iron in the bell to cause future trouble.

Personal

Dr. J. W. French, managing director of Messrs. Barr & Stroud, Limited, Caxton Works, Anniesland, Glasgow, has been elected President of the Royal Philosophical Society of Glasgow.

A pleasing function took place during the luncheon interval at Messrs. Smith & Wellstood's Columbian Foundry, Bonnybridge, last week, when a presentation was made to Mr. T. Murdoch by his fellow workers to mark the occasion of his approaching marriage. Mr. James Watson, departmental foreman, presided, and in wishing Mr. Murdoch future happiness and prosperity, asked him to accept an overmantel and a companion set.

Obituary

Mr. Edwin Laidler, a partner in the firm of Messrs. James Laidler & Sons, brassfounders, of New Elvet, Durham, died at the age of 75 recently.

Mr. William Galt, who has died at Vancouver, British Columbia, was an ironfounder, and brother of Mr. James Galt, of the firm of Henry & Galt, Limited. Mr. William Galt started a foundry in Calgary about 35 years ago, and later removed to Vancouver.

Mr. Robert Rodger, of the firm of J. M. Rodger & Son, Limited, Kyle Foundry, Ayr, died at his residence, 36, Fotheringham Road, Ayr, recently. Educated at Ayr Grammar School and Ayr Academy, Mr. Rodger was for some time in the employ of Messrs. William Brock & Company, Glasgow, before joining his father and elder brother in the Kyle Foundry in 1912.

New Companies

Enfield Foundry Company, Limited, Palace Gardens, Enfield, Middlesex.—Capital £1,000. Iron, brass and other metal founders. Directors: D. G. Bisset, senr., and D. G. Bisset, junr.

William Gratrix & Sons, Limited, Allen Street Ironworks, Bolton Road, Walkden.—Capital £6,000. Ironfounders, manufacturers of railings, gates and fencings, etc. Directors: J. Gratrix, Jesse Gratrix, Mrs. A. A. Gratrix and W. Gratrix.

Company Reports

Monk Bridge Iron & Steel Company, Limited.—Loss of £4,054, and there is a debit balance brought in of £161,395, making a total debit balance to be carried forward of £165,449.

Radiation, Limited. — Income from subsidiaries after charging taxation and general expenses, £298,961; dividend for the year on the ordinary shares of 12½ per cent.; to general reserve, £50,000; carried forward, £116,354.

Vickers, Limited. — Net trading profit for 1933, £816,361; income tax, debenture interest and other expenses, £272,997; dividends on preference share capital, £418,190; brought in, £222,022; dividend of 4 per cent. on the ordinary shares, £123,154; carried forward, £224,041.

Imperial Chemical Industries, Limited.—Net profit, £6,001,605; brought in, £543,770; final dividend of 5 per cent. on the ordinary shares, making 7½ per cent. for the year; dividend of 1 per cent. actual on the deferred shares; to general reserve, £1,000,000; carried forward, £566,139.

Coltness Iron Company, Limited.—Final dividend on the ordinary shares of 1s. per share and a bonus of 3d. per share, making with the interim dividend already paid a total distribution of 1s. 10.2d. per share for the year ended December 31, 1933. A sum of £65,000 is placed to redemption and depreciation account and £174,227 is carried forward.

British (Guest Keen Baldwins) Iron & Steel Company, Limited. — Profit, £222,101; contingencies, £30,000; redemption of income notes, £10,000; carried forward after interest on income notes and dividend on 6 per cent. redeemable cumulative preference shares, and after making good the balance of £20,457 at debit of profit and loss at December 31, 1932, £78,976.

General Refractories, Limited. — Profit, £30,585; brought in, £13,192; available, £28,100; to depreciation reserve, £2,500; bad debts reserve, £1,000; income-tax reserve, £2,500; to writing down trade marks, etc., £250; to writing down duty, etc., paid on share capital, £750; to general reserve, £3,500; final dividend of 8 per cent., making 10 per cent. for the year; carried forward, £10,400.

Morgan Crucible Company, Limited.—Net profit, £221,486; brought in, £917; preference and preferred ordinary dividends, £41,625; interest on 5 per cent. obligations, £1,517; interim payment on the deferred ordinary shares, £30,347; further distribution on the deferred shares, £67,437; capitalisation of 5 per cent. obligations to be retained for employment in the business, £80,925; carried forward, £551.

Baldwins, Limited.—Profit, £356,457; depreciation, £60,000; special expenditure at collieries, £4,853; directors' fees, £4,732; interest on 6 per cent. first mortgage debenture stock, £58,318; sinking fund for 6 per cent. first mortgage debenture stock, £11,277; interest on 6½ per cent. "A" debenture stock, £74,682; sinking fund for 6½ per cent. "A" debenture stock, £12,068; debit balance of profit and loss account brought in, £29,135; interest at 6 per cent. on the income debenture stocks, £64,152; income tax, £12,171; carried forward, £25,064.

Contracts Open

India, April 16.—Chilled cast-iron wheels, for the North Western Railway, Lahore. The Department of Overseas Trade. (Reference G.Y. 13,595.)

South Africa, April 13.—Cast-iron pipes, for the Durban Corporation. The Department of Overseas Trade. (Reference G.Y. 13,575.)

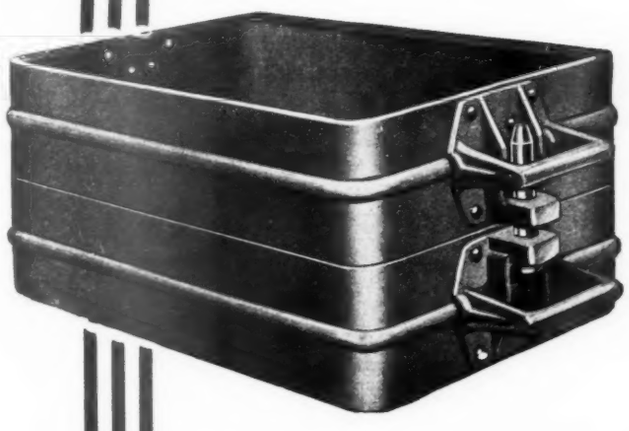
Coventry, April 2.—Installation of a pumping plant in duplicate at Mount Nod, near Coventry, for the Town Council. The Town Clerk. (Fee £3, returnable.)

Brasted, April 11.—Two vertical high-compression heavy oil engines with centrifugal pumps and other works at Sundridge pumping station, near Brasted, Kent, for the Metropolitan Water Board. The Offices of the Board, Chief Engineer's Department (Room 173), 173, Rosebery Avenue, London, E.C.1. (Fee £2 2s., returnable.)

Broughton, April 10.—(1) Laying and jointing about 6,500 yds. of 3-in. to 5-in. cast-iron pipes; (2) supply and delivery of about 180 tons of 5-in., 4-in. and 3-in. cast-iron pipes; (3) supply and delivery of hydrants, sluice valves and other fittings; and (4) erection of a 30,000-gall. reinforced concrete elevated tank, for the Rural District Council. Messrs. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

STERLING MOULDING BOXES

are an essential part of the equipment of every up-to-date foundry



The Sterling Box is more than "just a Moulding Box," it is an accurate tool for producing accurate castings with a minimum of labour and effort

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AGENTS AT MANCHESTER, GLASGOW & NEWCASTLE-ON-TYNE.
BEDFORD

Raw Material Markets

Business in the iron and steel markets has been on a good scale during the past fortnight, and the recovery that has been made is very satisfactory. Pig-iron continues in strong demand, and the increased output is readily absorbed. Increased building activity is proving beneficial to the light-castings industry.

Pig-Iron

MIDDLESBROUGH.—The demand for Cleveland foundry iron has fully justified the recent lighting-up of additional furnaces. The producers are fully sold at least to the end of June. The local foundries remain very busy, and quantities of Midlands iron are still having to be brought into the North-East Coast area. There has been no change in home quotations, No. 3 Cleveland G.M.B. foundry grade being quoted at 67s. 6d. per ton delivered Middlesbrough.

The East Coast hematite market is very firm. Makers' stocks are low, and the production only just keeps level with the demand, which remains unabated. Substantial contracts have been booked in South Wales, the Sheffield area and the Midlands. Official prices under the new zone system are based upon No. 1 East Coast hematite at 68s. per ton delivered on Tees-side, 70s. delivered Durham and Northumberland, 79s. delivered Birmingham, 74s. to 77s. delivered Yorkshire, 75s. delivered Scotland.

LANCASHIRE.—The volume of new orders from this area for pig-iron has fallen away lately, and will not pick up again until the holidays are over. The rate at which iron has gone into consumption has, however, been well maintained. With the exception of Widnes, where values of Midland irons remain on the old basis of 72s. 6d. per ton, offers of Staffordshire and Derbyshire brands of No. 3 for delivery in the Lancashire area are on the higher basis of 74s. per ton, with North-East Coast iron at the same figure, Northants at 72s. 6d. and Scottish No. 3 at about 82s. 6d. East Coast hematite is quoted for delivery in the Manchester district at 76s. for No. 1 and 75s. for No. 3, both unbroken, 2s. per ton more in each case for breaking.

MIDLANDS.—Although the same conditions do not prevail in all of the iron-consuming industries, generally speaking the level of activity is quite satisfactory. Somewhat better reports are received from the light foundries than from the heavy engineering works. There have been no changes in prices. The Midland pig-iron levels for delivery to Birmingham and Black Country stations are 67s. 6d. per ton for Northants No. 3 and 71s. per ton for Derbyshire, Staffordshire and Lincolnshire No. 3, these figures being subject to a graduated rebate to large consumers. Many consumers are covered for the first half of the year. Low-phosphorus foundry iron is offered at between 82s. 6d. and 90s. and medium-phosphorus from 75s. to 80s., while Scottish No. 3 is quoted delivered this district at 87s. 6d. to 90s. per ton. There have been no changes in the prices of hematite, neither is there much new business developing at the moment.

SCOTLAND.—Owing to inactivity in the heavy-engineering trade, the demand for Scottish iron is rather limited, but quotations are maintained at 70s. f.o.t. furnaces for No. 3 foundry, with 2s. 6d. extra for No. 1. No. 3 Cleveland iron is quoted at 67s. 3d. at Falkirk and 70s. 3d. at Glasgow, other English irons being obtainable at 1s. 3d. per ton less. A number of the light-castings foundries have bought into the third quarter.

Coke

The foundry-coke market is rather inactive at the moment, many users being covered. The producers are not prepared to quote for the last quarter of the year. Current prices, delivered in the South Staffordshire zone, are as follow:—Best Durham coke, 36s. 6d. to 40s.; Welsh, 36s. to 45s.; Scottish, 40s. to 41s. per ton.

Steel

The domestic consumption of semi-finished steel has been very satisfactory lately. New buying has not been very prominent, however, as many consumers are covered. Quotations from Continental works are at practically the same level as the British prices. The finished-steel market is definitely showing increased activity, although this does not apply to all sections. There is an active demand for small steel bars and steel strip, and a slightly increased call for some gauges of black sheets, but the galvanised-sheet trade remains depressed. Tinplates are quiet.

Scrap

A somewhat weaker tone has been seen lately in the Cleveland scrap-iron market, ordinary quality having declined to 50s., and machinery metal to 53s. There is a regular demand for material in the Midlands, where heavy machinery metal is offered at 55s., good heavy at 50s. and clean light metal at 47s. 6d., all delivered works. In South Wales, both heavy cast iron and machinery metal are decidedly quiet, at 46s. to 47s. 6d. and 47s. 6d. to 50s. per ton, respectively. The market remains fairly firm in Scotland.

Metals

Copper.—The demand from industrial consumers for this metal has been rather on the limited side lately, but the market has nevertheless maintained a fairly firm tone.

Writing of conditions in the United States, Messrs. Brandeis, Goldschmidt state that "negotiations for the Copper Code have failed to produce any tangible results. The idea of a minimum price will not be easy to carry out unless there is also some interference with normal methods of marketing, and it is indeed doubtful whether the code will be able to cover more than questions of wages and hours."

The week's prices have been as follow :—

Cash.—Thursday, £32 5s. to £32 7s. 6d.; Friday, £32 11s. 3d. to £32 12s. 6d.; Monday, £32 6s. 3d. to £32 8s. 9d.; Tuesday, £32 10s. to £32 11s. 3d.

Three Months. — Thursday, £32 10s. to £32 11s. 3d.; Friday, £32 15s. to £32 16s. 3d.; Monday, £32 11s. 3d. to £32 12s. 6d.; Tuesday, £32 13s. 9d. to £32 16s. 3d.

Tin.—Considerable fluctuations have lately been seen in the price of this metal. Quotations dropped heavily last week when it became known that there was a likelihood of a strike in the American motor industry, but a recovery was made on Friday, when the price of standard tin rose to £236 per ton for cash. Since then the price has risen to the highest levels seen since 1928.

Daily quotations :—

Cash.—Thursday, £234 17s. 6d. to £235 2s. 6d.; Friday, £236 to £236 2s. 6d.; Monday, £237 7s. 6d. to £237 10s.; Tuesday, £238 17s. 6d. to £239 2s. 6d.

Three Months.—Thursday, £233 7s. 6d. to £233 10s.; Friday, £234 12s. 6d. to £234 15s.; Monday, £235 5s. to £235 7s. 6d.; Tuesday, £236 17s. 6d. to £237.

Spelter.—"Though demand both for high-grade and lower-grade spelters has been quiet indeed in this country, prices have shown a slightly better tendency, due to a good demand being experienced on the Continent. Manufacturers here, continuing their policy of covering only their nearby requirements appear to be satisfied for the time being, and a temporary lull has resulted. We do not anticipate any prolonged falling off in the recent rate of consumption. It is understood that the recent tendency for Cartel stocks to decrease is continued," report Messrs. Henry Gardner & Company.

Price fluctuations :—

Ordinary.—Thursday, £14 13s. 9d.; Friday, £14 15s.; Monday, £14 15s.; Tuesday, £14 17s. 6d.

Lead.—Buying has been rather quiet lately, partly in view of the approach of the holidays, but the market has stayed fairly steady. At the moment there is little likelihood of an early upward movement in values. The February statistics in America show that, while production was cut down by over 4,000 short tons, stocks increased by over double that amount. The reserves of lead in America now stand at over 200,000 short tons.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £11 10s.; Friday, £11 12s. 6d.; Monday, £11 12s. 6d.; Tuesday, £11 12s. 6d.

Book Reviews

The Casting of Brass Ingots. By R. Genders and G. L. Bailey. With an Introduction by H. Moore, C.B.E. Pp. xv + 191, including five appendices. Illustrated, 63 plates, and numerous curves, diagrams and figures in the text. 1934. London: British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, N.W.1. (Price 15s.; postage 6d.)

This excellent volume presents, in summarised form, the results of a research having for its object the improvement of the quality of brass strip. The British Non-Ferrous Metals Research Association and Messrs. Genders and Bailey, respectively Deputy-Director of Metallurgical Research, Research Department, Woolwich, and Chief Officer, Development Department, British Non-Ferrous Metals Research Association, are to be congratulated on the publication of so admirable a "treatise" bearing on a highly-specialised branch of metallurgical industry. The word "treatise" has been designedly chosen as representing the true character of the work under review. To regard it as merely a summary of recent "research work" would be to rob the authors of the full meed of praise to which they are justly entitled.

It is impossible in a short review to give more than a very brief outline of the contents of the 14 chapters and five appendices into which the book is divided. The subject matter comprises a short historical review of the manufacture of brass from the earliest times; commercial melting and casting practice and later developments; brass-strip ingots, characteristics and defects; brass strip, surface quality and types of defects; composition, effects of added elements; teeming of the metal, solidification, feeding of ingots; dissolved gases; relative size of ingot and mould conditions; mould construction; modified and improved casting methods; special process methods; rolling mills and manufacture of strip and sheet; constitution and density of industrial brasses; special brasses.

The foregoing summary of the contents, although sufficing to show that the treatise is comprehensive in character, gives, however, but a poor indication of the practical value of the authors' brilliant analysis of the process of brass-strip ingot casting and the manufacture of brass strip and sheet.

"The Casting of Brass Ingots" is confidently recommended as a treatise which should be carefully studied by all those engaged in the manufacture of strip and sheet metals. It is a volume which, by its very excellence, no non-ferrous metallurgist can afford to ignore.

The volume is well printed, the plates are excellent and there is an index occupying four and a-half pages.

W. L.

Patents Explained. Written and published by H. J. W. Wildbore, Leadenhall House, London, E.C.3. Pp. 48. 5s.

This book outlines the formal items of British Patent Law. The author is a patent agent and, in concert with the practice of those patent agents who issue similar books, he confines himself mainly to matters which a patent agent should impart to would-be patentees who seek his services.

A knowledge of the book's contents can shorten the interviews between an agent and a client who has no previous knowledge of the formalities connected with applications for letters patent, but the book is not intended to give the reader instruction in the drafting of a patent specification nor in the laws and rules which govern the legal interpretation of patent specifications.

V. S.

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Genuine Cold Blast Pig Iron ———

Brands:

DUD·L.N.F'ces·DUD,
GRAZEBROOK,
LOWMOOR C.B.

——— the best insurance against defective castings

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.,
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Brand: "DUD·L.N.F'ces·DUD"

M. & W. GRAZEBROOK,
LIMITED,
DUDLEY, WORCS.
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THE LOW MOOR IRON CO., LTD.,
NEW WORKS, LOW MOOR,
BRADFORD - YORKSHIRE.
Brand: "LOWMOOR C.B."

MAKERS OF GENUINE COLD BLAST PIG IRON

RAW MATERIALS—PRICE LIST

(Tuesday, March 27, 1934)

COPPER

	£	s.	d.
Standard cash	32	10	0
Three months	32	13	9
Electrolytic	35	10	0
Tough	34	10	0
Best selected	35	0	0
Sheets	62	0	0
India	44	5	0
Wire bars	36	0	0
Ingot bars	36	0	0
H.C. wire rods	38	0	0
Off. av. cash, February	33	2	1⅛
Do., 3 mths., February	33	5	6
Do., Sttlmnt., February	33	1	9
Do., Electro, February	36	4	8½
Do., B.S., February	36	3	1½
Do., wire bars, February	36	10	0
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8⅜d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7⅝d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5⅜d.
Do. 4 × 3 Sheets	5⅜d.

TIN

	£	s.	d.
Standard cash	238	17	6
Three months	236	17	6
English	239	10	0
Bars	241	0	0
Straits	241	15	0
Australian (nom.)		—	
Eastern	238	0	0
Banca (nom.)		—	
Off. av. cash, February	226	16	2¼
Do., 3 mths., February	226	8	2¼
Do., Sttlmt., February	226	16	3

SPELTER

	£	s.	d.
Ordinary	14	17	6
Remelted	15	0	0
Hard	12	10	0
Electro 99.9	17	5	0
English	15	12	6
India	14	10	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., February	14	19	8¼
Aver. spot, February	14	16	10½

LEAD

	£	s.	d.
Soft foreign ppt.	11	12	6
Empire	11	17	6
English	13	0	0
Off. average, February	11	15	5⅝
Average spot, February	11	12	8¼

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex whse.	23	0	0
Rods	29	0	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	39	0	0	to	40	0	0
Chinese, ex-whse.					30	0	0
Crude					20	0	0

QUICKSILVER

Quicksilver	10	10	0	to	10	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/9 lb.
Tungsten metal powder—	
98/99%	3/- lb.
Ferro-chrome—	
2/4% car.	£32 0 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£37 10 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70%, carbon-free	10½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	2	12	6	to	2	15	0
Bundled steel and shrngs.	2	7	6	to	2	15	0
Mixed iron and steel					2	10	0
Heavy cast iron	2	6	0	to	2	7	6
Good machinery	2	7	6	to	2	10	0
Cleveland—							
Heavy steel					2	7	6
Steel turnings					1	17	6
Cast-iron borings					1	7	6
Heavy forge					2	10	0
W.I. piling scrap					2	5	0
Cast-iron scrap	2	10	0	to	2	13	0
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron					3	0	0
Steel turnings, f.o.r.					1	13	6
Scotland—							
Heavy steel	2	12	6	to	2	15	0
Ordinary cast iron	2	12	6	to	2	15	0
Engineers' turnings					2	2	6
Cast-iron borings	2	0	0	to	2	1	3
Wrought-iron piling					2	13	3
Heavy machinery					2	18	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	28	0	0
Brass	20	0	0
Lead (less usual draft)	10	10	0
Tea lead	8	0	0
Zinc	9	10	0
New aluminium cuttings	70	0	0
Brasiery copper	25	0	0
Gunmetal	26	0	0
Hollow pewter	155	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	9	12	6	to	9	15	0
Nut and bolt iron	7	5	0	to	8	0	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					13	15	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	5	0	to	9	10	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ⅝ in. (Untested)					8	12	0
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates	12	5	0	to	12	10	0
Hoops (Staffs)	10	10	0	& up.			
Black sheets, 24g. (4-t. lots)					10	5	0
Galv. cor. shts. (,,)					12	15	0
Galv. flat shts. (,,)					13	5	0
Galv. fencing wire, 8g. plain					14	10	0
Billets, soft					5	10	0
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	0	0	to	5	5	0
Tin bars					5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11⅞d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic, Valley	17.00
Bessemer	19.76
Malleable, Valley	17.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		16/3 to 16/9
,,	28×20 ,,		32/6 to 33/6
,,	20×10 ,,		23/6 to 23/9
,,	18¾×14 ,,		17/1½ to 17/3
C.W.	20×14 ,,		15/-
,,	28×20 ,,		31/- to 31/6
,,	20×10 ,,		21/6 to 21/9
,,	18¾×14 ,,		15/3

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Mar.	22 ..	32 5 0	inc. 1/3
,,	23 ..	32 11 3	,, 6/3
,,	26 ..	32 6 3	dec. 5/-
,,	27 ..	32 10 0	inc. 3/9

Standard Tin (cash)

		£ s. d.	
Mar.	22 ..	234 17 6	inc. 2/6
,,	23 ..	236 0 0	,, 22/6
,,	26 ..	237 7 6	,, 27/6
,,	27 ..	238 17 6	,, 30/-

Spelter (ordinary)

		£ s. d.	
Mar.	22 ..	14 13 9	No change
,,	23 ..	14 15 0	inc. 1/3
,,	26 ..	14 15 0	No change
,,	27 ..	14 17 6	inc. 2/6

Zinc Sheets (English)

		£ s. d.	
Mar.	22 ..	24 10 0	No change
,,	23 ..	24 10 0	,, ,,
,,	26 ..	24 10 0	,, ,,
,,	27 ..	24 10 0	,, ,,

Electrolytic Copper

		£ s. d.	
Mar.	22 ..	35 5 0	No change
,,	23 ..	35 10 0	inc. 5/-
,,	26 ..	35 10 0	No change
,,	27 ..	35 10 0	,, ,,

Tin (English ingots)

		£ s. d.	
Mar.	22 ..	235 10 0	No change
,,	23 ..	236 10 0	inc. 20/-
,,	26 ..	238 0 0	,, 30/-
,,	27 ..	239 10 0	,, 30/-

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
Mar.	22 ..	17 5 0	inc. 5/-
,,	23 ..	17 5 0	No change
,,	26 ..	17 5 0	,, ,,
,,	27 ..	17 5 0	,, ,,

Lead (English)

		£ s. d.	
Mar.	22 ..	12 15 0	No change
,,	23 ..	13 0 0	inc. 5/-
,,	26 ..	13 0 0	No change
,,	27 ..	13 0 0	,, ,,

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	0 16 9	0 15 0	0 15 6	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 0	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0‖	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	- ∞ -	2 3 6½
1922	1 7 0‖	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0‖	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10‖	2 1 0‖	2 1 6	2 0 9‖	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6‖	1 14 9	1 11 11‖	1 10 0‖	1 8 1‖	1 7 8‖	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5‖
1925	1 4 10‖	1 4 1‖	1 13 3	1 2 4‖	1 2 2‖	1 1 5‖	1 1 3‖	1 4 9	0 18 10‖	0 18 4‖	0 19 6‖	1 1 4‖	1 2 8‖
1926	1 2 1‖	1 0 9*	0 19 2‖	0 18 6‖	*	*	*	*	*	*	*	1 5 0	1 1 1‖
1927	1 5 6	1 4 9‖	1 6 1‖	1 3 9	1 2 6	1 0 8‖	0 19 4‖	0 19 0	0 18 7‖	0 18 0	0 17 10‖	0 17 6	1 1 1‖
1928	0 17 6	0 17 10‖	0 18 0‖	0 17 11‖	0 17 8‖	0 17 6‖	0 17 7‖	0 17 6‖	0 17 6	0 17 7‖	0 17 7‖	0 17 6	0 17 8
1929	0 17 7‖	0 18 0	0 19 0	0 19 6‖	0 18 10‖	0 19 10‖	1 1 3‖	1 1 8‖	1 3 0	1 3 6	1 3 8	1 3 1‖	1 0 9‖
1930	1 2 6‖	1 1 3	1 0 3	0 19 1‖	0 17 7	0 16 10‖	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2‖
1931	0 17 0	0 16 7‖	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0‖
1932	0 17 0	0 16 11‖	0 16 5‖	0 15 9	0 15 7‖	0 15 6	0 15 6	0 14 9‖	0 14 6‖	0 14 6	0 14 6	0 15 4	0 15 6‖
1933	0 16 0‖	0 15 11‖	0 15 6‖	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8‖	0 16 1‖	0 17 0	0 17 .0	0 18 0	0 16 1‖
1934	0 19 4‖	1 0 6	—	—	—	—	—	—	—	—	—	—	—

* Strike period. ‖ Five months.

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MANAGER, experienced, wanted for Brassworks, Clyde district, engaged production small brass castings, fittings, etc., chiefly marine outfits, including Admiralty work.—Write, No. 61, KEITH & COMPANY, Advertising Agents, 6, Castle Street, Edinburgh.

ASSISTANT CHEMIST (age 22-25) wanted immediately for foundry laboratory. Must be experienced in analysis of cast iron and usual foundry materials.—Apply, stating when free, age, experience and salary expected, Box 696, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Manager or Head Foreman desires position. Long experience in control of well-known foundries producing Diesel-engine castings up to 20 tons. Thorough knowledge of all types moulding practice and moulding machines, including sand-slingers. Accustomed to modern sand-preparing and core-making plant. Excellent record. (239)

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Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

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Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

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All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

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Pneu. Sand MOULDING MACHINE, boxes 16" x 16" x 6".
35" dia. "Sirocco" Cased FAN, 6½" cyls., 6" str.
Monometer MELTING FURNACE, 8" inside, 44" outside.
3 LANCS BOILERS, 30' x 8', 150 lbs. w.p.
RECEIVERS, 24' x 4' 6", 300 lbs. w.p.

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'Grams: "Forward." 'Phone: 23001 (10 lines)
ALBION WORKS, SHEFFIELD

MOULDING MACHINES.
Two 14-in. x 16-in. "Tabor," Split Pattern.
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Two 18-in. x 36-in. "Tabor" Shockless Rollovers.
Two 24-in. x 48-in. "Tabor" Shockless Rollovers.
Two 20-in. x 30-in. "Osborn's" Jolt Strippers
Forty other Machines in Stock.
A. HAMMOND,
Foundry Machinery Merchant, Slough.

SECONDHAND "Ketin" Patented Sand-Preparing Plant, capacity 3 tons per hr., arranged for direct motor-drive, and has one flat and one cage-type roller. In first class condition.—Apply, Box 694, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS

PATTERNS.—Inferior Patterns make trouble in the foundry. Why not buy the best—they cost very little more.—Send to FURNSTON & LAWLOR, Letchworth, Herts.

MISCELLANEOUS—*Continued*

LADLES—IN STOCK.
20-Ton Stevenson.
16-Ton Stevenson.
15-Ton Stevenson
12-Ton Evans.
10-Ton Evans.
8-Ton Evans.
6-Ton Evans.
5-Ton Evans.
Forty smaller Ladles in Stock.
A. HAMMOND,
Foundry Machinery Merchant, Slough.

STRAW ROPES, Etc.—Makers, WILLIAM OLSEN, LIMITED, Hull. We draw attention to our advertisement in the 1934 "Ryland's" Iron Directory, page 1510, for General Foundry Supplies.

FOR Sale, Foundry Crane Ladles, 3, 5 and 7 tons capacity.—RHYS W. HARRY, 58, New Road, Llanelly.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

6' × 6' × 8' Tilghman Sandblast room, similar to above, but with B.H.2 Tilghman horizontal compressor: price complete **£130**. Several small Tilghman plants.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1	£30
Rotary Sand Dryer by Titan	£55
Gyratory sand riddle with motor	£7

Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
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WROT IRON TUBES *for* **GAS, STEAM, AIR** *and* **WATER.**

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BOILER, WELL & HYDRAULIC TUBES.

LAP-WELDED IRON *and* **STEEL TUBES** *for* **ALL PURPOSES.**